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To Ernest C. Colwell,
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Leroy E. Loemker

October 4, 1956

LEIBNIZ
Philosophical Papers and Letters

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GOTTFRIED WILHELM LEIBNIZ

Philosophical Papers and Letters

A Selection Translated and Edited, with an Introduction by

LEROY E. LOEMKER

VOLUME I

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PREFACE

The selections contained in these volumes from the papers and letters of Leibniz are intended to serve the student in two ways: first, by providing a more adequate and balanced conception of the full range and penetration of Leibniz's creative intellectual powers; second, by inviting a fresher approach to his intellectual growth and a clearer perception of the internal strains in his thinking, through a chronological arrangement. Much confusion has arisen in the past through a neglect of the development of Leibniz's ideas, and Couturat's impressive plea, in his edition of the *Opuscules et fragments* (p. xii), for such an arrangement is valid even for incomplete editions.

The beginning student will do well, however, to read the maturer writings of Parts II, III, and IV first, leaving Part I, from a period too largely neglected by Leibniz criticism, for a later study of the still obscure sources and motives of his thought.

The Introduction aims primarily to provide cultural orientation and an exposition of the structure and the underlying assumptions of the philosophical system rather than a critical evaluation. I hope that, together with the notes and the Index, it will provide those aids to the understanding which the originality of Leibniz's scientific, ethical, and metaphysical efforts deserve.

My indebtedness to all who have in some measure aided me in the preparation of the translations and interpretations is so extensive as to forbid detailed acknowledgment. Professor Paul Schrecker, whose knowledge of the thought forms and relations of Leibniz, and, indeed, of seventeenth century thought in general, is unsurpassed, has read and corrected a large number of the translations, particularly in Volume I, and should be credited with setting norms for accuracy and adequacy.

Professor Elizabeth DeLacy has exercised extensive editorial

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supervision, caught many defects, and suggested changes which have consistently improved the work.

Beyond the extensive work of these, there are many others who deserve my gratitude for help rendered. A fellowship of the Rosenwald Foundation in 1938 and a grant from an anonymous source in 1951 enabled me to begin a detailed study of Leibniz, to make use of the Hanover manuscripts, and to confer with European scholars. The editors of the Prussian Academy edition, and the directors of the Hanover Landesbibliothek, gave generous advice and opportunities for study. Professor Helmut Kuhn, now of the University of Munich, checked the translations. For detailed answers to many questions I am indebted to more friends and colleagues than I can conveniently name.

Publication was subsidized in part by a grant from the Research Committee of the University Center in Georgia, generously enlarged by Emory University. More important even than this, however, has been the climate of study provided by Emory University and its administration during troubled years of war and of uncertain peace.

To acknowledge with gratitude the social co-operation required in such work is a pleasure which does not, however, remove the uneasy recognition that the responsibility for errors and other blights on the usefulness of these translations, being the fruits of solitary decision, must be borne by the translator and editor himself.

All parentheses in the text are Leibniz's own, though some of his parentheses have been removed. All editorial interpolations are in brackets. Titles used by Leibniz in his writings are in capitals; underlined titles are merely editorial labels, though many of these have become well established and generally accepted. Leibniz's own underscoring has been retained except when he used it to indicate direct quotation. The keys used throughout in references to the editions of Leibniz and related works may be identified in the Bibliography.

Emory University, Georgia

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INTRODUCTION: LEIBNIZ AS PHILOSOPHER

The three hundredth birthday of Gottfried Wilhelm Leibniz was widely observed in 1946 but nowhere more appropriately, though unintentionally, than by the complex ritual of exploding the fourth atomic bomb at Bikini on the exact anniversary day, July 1.[1] It is not only that he was the first to argue that force is the essence of matter. It is rather that, second to none in his faith in science, and a forger of its new mathematical tools and social instruments, the academies, he was also vigorous in opposing the divorce between truth and action, and between power and its moral controls, which was already weakening the Western will. No event could better have reminded the thoughtful of the power released by modern science and of the failures of modern wisdom. It was the seventeenth century whose great achievements and crucial decisions led to our own cultural conflicts, but it was the wise men of that century, too, who first saw the dangers and sought ways of avoiding them. And among these Leibniz was one of the last to offer a unified and inclusive answer for the problems of European life.

Our century can appreciate a man whose motto was "Pars vitae, quoties perditur hora, perit," and who expressed his sense of the dynamic in such maxims as "Aus Taten werden Leute."[2] Not only have we verified his conviction that substance is activity. We are still working to achieve his dream of a universal grammar and strategy of science. We have rediscovered the value of his idea of an "art of symbols" to standardize mathematical operations, mechanical assemblies, and orderly procedures of all kinds. The great calculators which we have constructed are more perfect applications of a conception which Leibniz applied to the complicated little mathematical machines on which he spent his income for so many decades. We have overtaken and surpassed his insights into mathematics, logic, and psychology. But our greatest unsolved problem is still, in essence, that whose solution served as a unifying goal of his efforts—a scientific, legal, religious, and moral basis for social order.

It is timelessness rather than timeliness, however, that justifies the study of a philosopher. The fascination which Leibniz's insights have aroused in so many minds is due less to his relation to his own times—or to ours—than to the breadth and substance of his thought. Though he never philosophized in a vacuum, the range of problems upon which he worked creatively was wider than that of any other modern thinker; it covered the entire intellectual enterprise from mathematics and logic through the sciences to ethics, law, and theology. He was continuously engaged with these problems for over fifty years, sometimes attaining clarity and sometimes not, but always striving for coherence and harmony through the formulation of first principles. His spirit was at once creative and conciliatory, a rare combination which Bertrand Russell and others have held destroyed his integrity as a thinker. Most important of all, the principles of method in terms of which he sought to harmonize all truth form one of the enduring types of philosophy, and those who approach speculation from logic, or mathematics, or science, or religion have repeatedly been impelled to return to them. He himself defined the grounds which, paraphrased, justify a more extensive translation of his works; in preparing an edition of Marius Nizolius, an obscure rhetorician of the century preceding, he gave as his reasons "a basis for discourse, and the time of the author; a basis for discourse, because it is worthy of a philosopher, and the time of the author because he is worthy of our own" (G., IV, 138; cf. No. 8, below).

I. The Seventeenth Century

The time of the author is the clue to his motives as philosopher. The seventeenth century stirred with decisions—and with a growing fear of crisis. The heir of the Renaissance, it felt the spirit of freedom and mastery but also the rude shocks and clashes which marked the collapse of those medieval controls upon which it still depended in government, law, education, and religion. The Treaty of Westphalia, ending Europe's most devastating war—until our own days—had finally destroyed Europe's devotion to the old bases of peace and unity and had substituted the principle of nationalism sanctioned by religion and buttressed by power politics. The interests of royal families, different languages, and separate traditions of law and culture were spurs to political pluralism; but a much-altered Corpus Juris Civilis, the Turkish danger, a Pan-European educational system surviving from the Middle Ages, and the new science provided some impetus toward political and cultural unity.

Between the opposing forces of unity and disintegration, of conservation and innovation, were diplomacy and the churches. The balance of power shifted as adroit statesmen countered the dangers of concentrated power. Of the old Holy Roman Empire there remained but the titles and trappings and an aggregation of states whose self-interest often conflicted with their loyalty to the remaining focus of the empire in Austria. France, now unified, became the center of European power and the symbol of its culture. In England and Holland political revolution was determining the principles of modern liberalism, and its human type as well—the citizen-patriot-merchant. The small courts of northern and western Europe became unduly powerful through their bargaining strength in the great game of war potentials; Mainz, Hanover, and Berlin, to mention only three with which Leibniz was intimately involved, were not second in political astuteness even to Paris, London, and Vienna. The economic patterns of the Renaissance had made possible the accumulation of new wealth; explorer and entrepreneur provided new materials and new crafts for the enrichment of the new nations. However slow by modern standards, commerce and communication[3] were creating a European taste. Modern economic theory and practice were evolving and being fixed, partly in the cabinets of monarchs, partly in the counting-houses of merchants; capitalism and the beginnings of state socialism thus developed side by side, until the destruction of absolutism in government facilitated the triumph of private enterprise.

Divided against itself, Christianity too became the tool of power. Having failed to control the new forces of nationalism and capitalism by imposing a unitary moral order upon them,[4] the church now became involved in an effort to revive its own spiritual power. Theological controversy was the inevitable intellectual deposit from this effort; the problem of divine grace and its relation to man's freedom engaged Catholic and Protestant alike, with the mystics adding the force of living experience, but confusion as well. Jesuits were viewed with distrust because their compromises and strategy fitted the new spirit of freedom too well; Jansenists were condemned for their misgivings about this same freedom. Since the fall of Rome, Christianity had never been more self-critical, and theological argument had become the tool of this critical re-examination.

Most unifying and productive, however, seemed the rapid advance of science and technology. The seventeenth century felt a simple awe at the wonderful harmonies of nature which science was revealing and at man's power in creating tools for discovering them. With a rapidity that may seem appalling in retrospect, the age permitted a breach to widen between the humanistic and the scientific interests of the Renaissance. Early in the century scientists had developed both a permanent method and a social aim. The method was at once experimental and mathematical, Kepler and Galileo having shown with what advantage the two might be combined. The aim was universal well-being; Bacon had popularized the human worth of the new science. Yet the tendency to reduce human ends to such as could be attained by scientific discovery and control alone soon followed. Before the century closed, Leibniz himself could write to his friend Thomas Burnet as follows, despite his high esteem for Vergil, whom he once called his Leibbuch second only to the Bible.

> I do not begrudge the excellent Mr. Dryden the fact that his Vergil has won more than a thousand pounds sterling for him; this is the least that he deserved. But I wish that Mr. Halley might gain four times as much, at least, to make his voyage around the world and discover for us the secret of magnetic declination, and that Mr. Newton might gain this tenfold, and even more, to continue his profound studies without interruption. I am distressed at the destruction of Holbein's pictures, which were burned at Whitehall; yet I am a little in the sentiment of the Czar of Muscovy, who, I have been told, admired certain ingenious machines more than all of the pictures which he was shown in the royal palace [1698; G., III, 222-23].

Curiosité came to rank high among the courtier's virtues, as every man of intellectual pretensions became also a scientific dilettante. While universities, with notable exceptions, still sought to admit humanistic learning without ceasing to be strongholds of Scholasticism, the new science was forming its own social instruments independently, in the scientific academies and journals.

In spite of the promise of scientific universalism, however, the age of Leibniz felt within itself the beginnings of tragedy, sensing its failure to perfect its social and moral controls. This sense of conflict and impending collapse appeared in the ethical problem of the nature of the just and the free man. The English Revolution was a revolution of Puritans, that is to say, Augustinian Platonists. Beginning as a revolt against tyrants in the interest of law, it implied a new conception of the individual—one essential to a century preferring order to freedom. Whatever their other differences, few of his critics disagreed with Leibniz's own conviction that true freedom must be consistent with universal harmony. Most of them, like him, feared another revolution, in which the libertine, the _esprit fort_, threatened to replace the man of honor (_homo honestatis_, _homme honnête_).[5] The latter was the courtier, who found his true freedom in exemplary obedience to the law of his sovereign and his court. The libertine, in contrast, demanded a freedom independent of external law and order, seeking to create his own law from within. The literature of the century abounded in praise for the one but showed a persistent distrust for the other. The crisis of the

European consciousness, which Paul Hazard has placed in the years of Leibniz's mature activity,[6] was the crisis of the honorable man, who must either give way to the libertine or find an object of allegiance more permanent and universal than that of earthly ruler and law.

It is in this crisis that Leibniz takes his stand with the honorable man, and it is through his eyes that he seeks an intellectual basis for Europe's future. Science, law, and religion are to be grounded on universal order and a universal monarch, the ruler of the inseparably interwoven kingdoms of nature and of grace. It is only by allegiance to such an order that the man of honor, his _honnêteté_ enlarged by the cardinal virtues of _curiosité_ in science, _charité_ in human relations, and _piété_ toward the supreme ruler, can preserve himself and Europe.

II. Leibniz's Life and Work

Leibniz was two years old when the Thirty Years' War ended, having been born in the old Protestant university town of Leipzig in 1646. His childhood and youth were spent in an academic atmosphere, for both parents belonged to families esteemed for their connection with the university and the legal profession. His intellectual growth was precocious, though perhaps not so much as he later recalled it to be, and the autodidacticism of which he later boasted seems to have consisted chiefly in a certain independence and originality in pursuing studies which interested him beyond his school work—first Latin and history, then the Church Fathers, and later the logical structure of propositions and syllogisms. More significant, perhaps, is the sense of a call with which his father, impressed by certain omens of divine favor toward the young child, may have imbued him before he died in Leibniz's sixth year. One of the pen names under which the great projects for the unification of science and religion were later planned was partly translation and partly transliteration of his own name, Gottfried Leibniz, into Pacidius Lubentianus, a form expressive of the religious virtues of peace and good will which he sought to nurture.

Leibniz's university training, which pointed toward legal scholarship, was not outstanding. Except for a semester at Jena, where he heard the lectures of the erudite and imaginative Erhard Weigel, reconciler of Plato, Aristotle, and Euclid, his studies were completed in the still strongly Scholastic tradition of his home university. Instruction served to develop the weighty learnedness which his early works display, but of his teachers only Jacob Thomasius seems to have stirred him to an active will to engage in the living issues of thought (No. 3). It was probably in 1664, after three university years, and not at the age of fifteen, as he himself later recalled, that he walked in the Rosenthal, trying to decide between the old philosophy of substantial forms and the new of atomism and the machine, and at length cast his vote for the new, yet without ever really rejecting the essentials of the old. His early writings indicate that, aside from Bacon, he knew the moderns only by hearsay or through the compendious summaries of his textbooks; he began the serious study of Hobbes several years later and of Descartes only during his years in Paris after 1672. With little mathematics beyond Euclid, but with a thorough knowledge of traditional philosophical and theological issues, he went into the study of law, succeeding, as he later says, in mixing some practical experience with his theoretical learning. For unclear reasons, apparently related to a failure to receive priority for a subordinate post in the law faculty, he withdrew to the University of Altdorf after completing his baccalaureate in law, and there he received a doctorate and was eventually offered a university position.

Four academic writings contain the beginnings of Leibniz's own thought, but with one exception their importance for the student of his philosophy is only indirect. This exception is the Dissertation on the Art of Combinations, published in 1666 as the first fruit of his logical studies. It points to a program for arriving at an exhaustive inventory and arrangement of human knowledge by means of a method of analysis and synthesis, using principles of permutation or combination as the basis of its enumerations—a refinement of the old Lullian art. Leibniz's later conception of a universal calculus was to grow out of the position developed in this work (No. 1). Of the other three, the earliest is a display piece in traditional Scholastic form, the Metaphysical Disputation on the Principle of Individuality (1663), important only because it concerns one of his basic philosophic emphases; the others are studies in legal casuistry, applying probability to the settlement of doubtful cases in the law. They have some bearing on the development of his later ideas about truths of fact.

In Nürnberg, however, a center in which the new sciences were beginning to flourish and where he himself was inducted into the Rosicrucian Society, his mind seems to have teemed with projects to be achieved at courts, not in universities—projects for the reform of law and of education for the law; for academies, libraries, and other agencies for advancing science; for the strategy of European politics. A chance meeting with the Baron John Christian von Boineburg, brilliant diplomat and statesman, led him to seek an appointment at the court of the Bishop Elector of Mainz, John Philip of Schönborn, and academic robes were laid aside permanently for the more modish raiment of the courtier. Except for four years in Paris from 1672 to 1676, the rest of his life was spent in residence at courts—at Mainz until 1672 and at Hanover, with frequent and long absences at Berlin and Vienna, in Italy, and elsewhere, from 1676 until his death in 1716.

It is with this decision that the motives of Leibniz's activities and thought merge with the needs of European order. It may be said that his life was henceforth impelled in two opposite directions; the man of action and the scholar found it hard to achieve their aims within a single lifetime.

On the one hand, there was the diplomat, counselor, unofficial historian, and tutor of princes and princesses; the adviser of statesmen, kings, and emperors. The rapidly changing map of Europe, which resulted from nine great wars and as many peace settlements in his lifetime, made it inevitable that much of his official activity should be devoted to the transient play of power politics—to restricting the power of France and maintaining that of the crumbling empire, to advancing the influence of the smaller states, particularly of Hanover, whose house he helped elevate to an imperial electorate and then to the throne of England. His political realism is well shown in an analysis of the European situation written in 1670, in which he described the causes of political tension and proposed a plan for federation and collective military security to maintain peace.[7] The elaborate proposal which he and Boineburg drew up the next year for a French crusade against Egypt, and which he carried to Paris in 1672, failed to divert Louis XIV's military ambitions from Europe, for the Sun King had already laid his plans for the invasion of the Low Countries. But the plan reveals an early understanding of the geographic, economic, and cultural factors in political strategy which later years sharpened, so that Leibniz's services as counselor were sought after by Prussia, Austria, Russia, and even the Vatican; with Peter the Great he had three conferences and an extended correspondence looking toward the modernization of Russia.

Yet his hopes for Europe rested upon deeper and more enduring plans, and it is with the promotion of these more permanent cultural goals that his long-term intellectual efforts were concerned. Four lifelong projects, any one of which might have absorbed the full energies of a man without success—and in none of which, it may be added, Leibniz himself succeeded—occupied the leisure he was able to find for them.

1. Of these plans, the first in time concerned legal reform. His academic studies of doubtful cases in the law had convinced him of the need of a stricter and more universal method in legal rules and decisions. John Althus' suggestion that the confused state of European law could be simplified by finding more logical classifications than those of the Roman Corpus Juris had early impressed him,[8] and the small work which helped him to secure

his first appointment, the New Method for Learning and Teaching Jurisprudence (No. 2; cf. No. 4), proposed a psychological and a logical basis for simplifying law, together with a philosophical grounding of the law of nature. At Mainz, where he assisted Herman Lasser in a project of recodification, he undertook to prepare the general parts of a work on Rational Jurisprudence, only incomplete studies for which were ever written (No. 6). Leibniz expected great values to develop from his work; in a letter to John Philip on March 27, 1669, he claimed to have

> prepared, among other things, a table, comparable in size to a map, which uses a unique arrangement and method to present the entire common private law of the Empire today, with all of its fundamental rules and propositions, and reduces them to first principles so that any one who understands this table, or has it lying before him, can decide any fact or case of private law, and at once put his finger on the basis for the decision in the table itself [Guh. L., I, Anhang, 9-10].

The work of Hugo Grotius had fastened in his mind the need of European peace as the practical goal of legal reform;[9] his own logical and philosophical interests made him seek the principles of logic and ethics upon which a normative system of law and justice must rest.[10] His efforts to reduce the law to its primitive notions were therefore but one application of the universal method of analysis and synthesis, or of judgment and invention, which was one of the poles of his philosophical work. This in turn required a new science, the universal characteristic and logical calculus, for its perfection. The metaphysical foundations of the law, on the other hand, he found in a Platonic theory of ideas, which was in turn supported by his mathematical, logical, and theological studies and became one of the permanent components of his system (Nos. 5, 6, and 9). With this foundation he was able to find a common theoretical bond between theology and law, which his more empirical investigations in physics and psychology were intended to support.

2. More persistent, however, than his efforts to establish a basis for European order through legal reform were his projects in religious unification. Leibniz was well aware that the religious

controversies of the century were often cloaks for more earthly designs; in 1683, for instance, he wrote a skilful satire, the Mars Christianissimus, attacking the pious pretensions of Louis XIV. Recognizing that the divisions of religion, closely related to those of political power into states, intensified religious conflict, he made vigorous efforts to bring first Roman Catholics and Protestants, and later the Lutheran and Reformed wings of Protestantism, into agreement on church polity and doctrine—efforts which involved much theological writing and hundreds of letters to such leaders as Bossuet, Arnauld, Pellisson, and the Abbess of Maubisson and her secretary, Mme de Brignon. In this enterprise Leibniz was not moved merely by political motives, as some interpreters have held, but by religious conviction and an interest in the validity as well as the social effectiveness of the Christian faith (Nos. 5, 23, 28, and 40). Indeed, his interest in religion, like his historical and political interests, extended beyond Europe; the American Indians, about whom he had direct information from the Baron de la Hontan and others, impressed him with a natural Adamic piety and morality, while the morality of China, on whose language and culture the Jesuit missionaries kept him informed, contrasted so favorably with Europe's that he suggested that "considering the rapidly growing decline of manners in Europe it is almost necessary for the Chinese to send missionaries to teach us the purpose and practice of natural theology, as we send missionaries to instruct them in revealed theology" [Dut., IV, 280].

For Leibniz and his contemporaries, ecclesiastical unity meant theological unity and was therefore to be attained through Christian apologetics and an authoritative agreement on church polity. Early in his career (1669) Leibniz outlined a work entitled Catholic Demonstrations, an apologetic study which was to be based on philosophical principles and to be absolutely conclusive—a sound basis for European unity and the immediate evangelization of the world (No. 5). Many studies were prepared, but the work was left incomplete. Soon after he came to Hanover he revived the project with the hope of getting the Catholic Duke John Frederick to support it (No. 28); after the death of that patron in 1679, he interested Count Ernest of Hesse-Rheinfels in his plan. Here, as in his other grandiose schemes, he became absorbed in the parts and never completed the whole. But the "little discourse in metaphysics" which provided the basis for his long philosophical correspondence with Arnauld (Nos. 35, 36, and 38) may well have been written as a part of the philosophical introduction for the Catholic Demonstrations; in any case, it is significant that not only Leibniz's metaphysics but his logic and physics were developed as a foundation for his theology (Nos. 5, 8, and 10). Though the extensive writings on dynamics in the 1690's (No. 46) arose as an independent interest, he always insisted upon their theological bearing (No. 50).

It has often been pointed out that Leibniz philosophized best in controversy with others and also that his spirit in such controversy was irenic and conciliatory. It has not been sufficiently emphasized, in reply to those who find two thinkers in Leibniz—a good logician and a bad theologian—that his philosophical controversies, whether with the Jansenist Arnauld or the skeptic Bayle, with the Cartesian De Volder or the Jesuit Des Bosses, are irenic because they are always concerned with theological issues as well. The most important problem was logical, metaphysical, and theological all together; it was the problem of the relation of individual to universal, of concrete subject to its predicates, of man to nature, of human freedom to divine grace. His criticism of men like Spinoza, Sturm, and even Malebranche was that they denied power, and therefore existence, to individuals; on the other hand, Hobbes, Bayle, and Newton (as interpreted by Clarke) encouraged naturalism and the complete independence of the individual—in short, libertinism.

3. If religion and law were to provide the pattern and motive of European harmony, the advancement of science and technology was to supply the tools. It was high time, Leibniz felt, for Bacon's vision of the advancement of learning to bear fruit in a program

of organized research, Pan-European in scope and universal in content. His letters reveal the ardor with which he drove forward his own investigations and challenged the co-operation of others. When he went to Paris in 1672, he was ignorant of mathematics beyond Euclid and some ideas of Cavalieri; he had discovered the essential processes of the calculus before he left four years later.[11] The notion of mathematical function and the symbolic and operational tools which he built upon it for the physical sciences were for him an outstanding instance of his more general science of symbolics and a clue to the philosophic interpretation of individuality and process. The mathematical principles of continuity and equivalence he used as effective tools in physical analysis, and he showed the necessity of the notion of vis viva and its conservation in closed systems. Not all his inventions and discoveries were capable of arousing the interest of his contemporaries, as did his calculating machine and the new mechanical devices which it embodied; his proposal for a geometry of situation (No. 27) failed to interest even his friend and mentor Huygens, and his logical studies were so far beyond his contemporaries in sharpness if not in conception (for related projects had been made public by Lullus, Wilkins, Kircher, and others) that publication was out of the question.[12]

Leibniz's letters and papers are a rich mine of information about the arts and crafts of the century. No new mechanical principle or natural discovery was too trivial for his attention, and few of the achievements of the day can be named in which he did not have a hand: the discovery of phosphorus and its manufacture as a weapon of war (No. 27, I) (here, again, it remained for the twentieth century to execute his purpose); the discovery of European porcelain; the use of microscopes in research; Papin's steam engine, for which he proposed a self-regulating mechanism and the re-use of the expended steam; the principle of the aneroid barometer (No. 49); machinery for the uniform distribution of power in pumps, which he himself devised in his unsuccessful efforts to rid the silver mines of the Harz of superfluous water; and proposals for improving clocks, navigation, and coinage and the economic theory on which it rested.

He was an innovator and discoverer in the field of the social sciences as well. The significance of his historical methods and results has been exaggerated,[13] but his collection of political documents from the Middle Ages, published in 1693 and 1700 (No. 44, I and II), is one of the beginnings of the modern collection of sources; and his history of the House of Brunswick, which turned into an exhaustive study of the Middle Ages and was later used by Gibbon, emphasized the creative and enlightened character of the eleventh and twelfth centuries in contrast to the darkness which preceded and followed them. Meanwhile he prefaced his history with the Protogaea, an account of the development of the earth and life upon it, for he believed that we must first understand the earth if we are to understand the people who inhabit it.[14] The science of linguistics began in his efforts to prepare a comprehensive comparative dictionary of the common terms of all known languages, a project preliminary to the more general one of developing a universal language; this in turn was an aspect of his universal characteristic or science of symbols. He succeeded to a degree in tracing the great migrations from the local names they deposited throughout Europe and discovered some of the rules for the evolution of language. His interest in education is shown in many letters and papers (No. 2).

But, though himself a genius, Leibniz considered scientific advance as the work not of individual geniuses but of scholarly co-operation. Hence he commonly used his own studies to build and strengthen co-operative work in science. A member of the British Royal Society and the French Academy, he himself planned the organization of the Prussian Academy on broader intellectual bases and drew up plans for similar academies in Mainz, Hanover, Vienna, Dresden, and St. Petersburg, though the continuation of political conflicts kept these from being founded. The church, too, was to support research; monasteries were to be reorganized into institutions for scientific and technological advance, and he suggested an Order of God-lovers (Ordo Theophilorum) or an Ordo Caritatis Pacidianorum,[15] whose members were to prepare a universal language and encyclopedia and then serve as missionaries to use this newly organized knowledge in the improvement of the well-being of all peoples.

It is in his proposals for a unified method and apparatus for this uncovering of the foundations of the sciences and ordering their results that Leibniz's scientific interests, in their turn, pass over into philosophy. The general tool for investigation was to include a universal language for spoken and written communication, another language of symbols for scientific analysis and synthesis (the universal characteristic), a calculus for using them in discovery and analysis, and a universal encyclopedia based on this characteristic and logic. To the several parts of this project he returned at regular intervals in his life, particularly at the periods centering in 1670, 1679, and 1690, and he never abandoned it (see Nos. 1, 10, 13, 19, 24, 25, 26, and 41).

4. In these efforts at scientific, religious, and legal reform, Leibniz never lost sight, however, of the basic motive, which was the well-being of man and his happiness. In his humanitarian hopes he was a true individualist and internationalist; at the same time that he urged a sound patriotic interest in the German language and culture upon his countrymen he was planning similar developments in Russia. To Count Golofkin he wrote:

> In this I make no distinction of nation or party, and I should prefer to see the sciences made flourishing in Russia rather than given only mediocre cultivation in Germany. The country which does this best will be the country dearest to me, since the whole human race will always profit from it [1712; Foucher de Careil, Oeuvres de Leibniz, VII, 503].

And to Des Billettes he said, in discussing the restoration of the French Academy's work after the Peace of Ryswick:

> Provided that something of consequence is achieved, I am indifferent whether it is done in Germany or in France, for I seek the good of mankind. I am neither a phil-Hellene nor a philo-Roman, but a phil-anthropos [1697; G., VII, 456].

All Leibniz's projects meet, therefore, in the need for a philosophy and, specifically, an ethics for the man of honor. True piety is to be identified with charity. The basic need of the century is the commitment of honorable men to the universal rather than to the relative and particular. Leibniz was no democrat,[16] though he was within limits a hedonist, a liberal, and an individualist. He was a friend of princes and looked for leadership in advancing man's well-being to "those great men in whom alone there is hope of improvement in this greatest of centuries." Such men must be brought to a philosophia perennis, the synthesis of what is good in all systems. They must be brought to understand what is truly universal and how moral individuality is related to it. Clearness and distinctness of ideas are the first requisites of true honor, for it is only reason, and the creative will based on it, that man and the supreme monarch have in common. The honorable man must live on the highest level of the law, above strict law and equity (Nos. 6, 44, and 59), and therefore above merely positive law. His great principle is that "of justice and true piety as well, for to contribute to the public good and to the glory of God is the same thing" (G., III, 261). He must be a member of the realm of grace; and the relation of this realm to the individual and to the realm of nature, it is the purpose of Leibniz's philosophy to make clear.

Of course he failed. Part of his failure was the result of his own many-sidedness; he either did not see or was not free to apply Goethe's later wisdom: "In der Beschränkung zeigt sich erst der Meister."[17] Part of it lay in the inherent difficulties, not to mention impossibilities, in his plans. But some of the failure was not his but his century's, for it followed other guides and made other choices; going further and further along the way of pluralism and individualism, it retained his faith in science and technology but rejected his quest for moral, religious, and legal unity. The suddenness of the change and the quickness with which the molds of modern Europe were set are still strange to contemplate: as Hazard points out, the French people, who were still thinking like Bossuet at the end of the century, were by 1750 thinking like Voltaire. And the problems which arose in Leibniz's own age have become inescapable in ours.

In his old age, ordered by George Louis to persist in the task of completing his history of the House of Hanover while the court was settling in London, goading himself to his burden through various counterirritants to the gout, Leibniz predicted the early revolution, yet still sought and encouraged the "great prince" and the man of honor. As vigorous as ever in controversy (No. 71), as friendly and painstaking as ever with correspondents, he died neglected by his master, with his profoundest thoughts unpublished and his many creative dreams buried in a mass of manuscript.

Some of the virtues and faults distinctive of Leibniz's philosophy arise from certain peculiarities in his mode of work, which it will be useful to remember in reading him. Fontenelle said that Leibniz bestowed the honor of reading them upon a mass of bad books. His inclination was to read everything, to read it rapidly, and to understand it in relation to the perennial philosophy which he proposed to found. His own insights came most readily in reaction to the view of someone else whom he read or with whom he corresponded or conversed;[18] the independent exposition of his own opinions seems to have come hard to him. His own education, except in mathematics, was one by books rather than inspiring teachers—and these books were chiefly texts in the Scholastic manner. Suárez's Disputationes metaphysicae had become the academic standard of doctrine for Protestant and Catholic Europe alike, and a host of smaller works were written further diluting, supplementing, altering, or rejecting his already modified Aristotelianism in favor of Platonism, Ramism, Phillipo-Ramism, the modern corpuscular theory, or Cartesianism. To his textbooks Leibniz's reaction was always independent, yet their immediate effect, like that of most texts, was a rapidly acquired show of erudition, sometimes without exact knowledge (see especially No. 3), a glib use of terms without, always, a firm grasp of the restrictions imposed by their history, and a body of ready-made opinions without the time to penetrate their implications.

Leibniz's active philosophical career thus begins with his general convictions already accumulated (though not yet formed); like the texts he used, he was an eclectic. He was always at home with Scholastic terms, concepts, and problems; the old bottles into which he tried to pour the wine of his new notions of individuality, force, and mathematical function are the medieval categories of substantial form, causality, active and passive intellect, primary and secondary matter, primary and secondary power. In spite of inherent difficulties, Leibniz boldly imposed Aristotle's predicables upon his dynamic monadism. Since Scholastic terms, however confused, still provided the most general medium of learned discourse, this was not entirely a misfortune. Yet it had the consequence of introducing many misunderstandings of his meaning, both among his contemporaries and later.

Some of Leibniz's difficulty is therefore terminological. The seventeenth century was fixing the language of modern science, and Scholastic terms were proving inadequate for the new discoveries. Leibniz was aware of the importance of fruitful symbols for the pursuit of truth and showed himself a great inventor of such symbols—for example, in the calculus, in logic, and in geometry. He was a connoisseur of the apt phrase as well, and the place of analogy in his method made the substitution of the figure for the principle a constant temptation, though his effective popularizations can usually be translated into the more rigorous logical terminology of his critical writings. His several sets of terms—the Scholastic, the mathematico-logical, and the popular—may well confuse the interpreter who has failed to establish equivalences among them.

This complexity must in turn be accounted for by the universality of the task which Leibniz set for himself. A perennial philosophy requires social co-operation, the criticism of all existing systems, and the inclusion of all the fields of human knowledge and endeavor. Leibniz's main concern was to avoid sectarianism but to invite helpful criticism, and the effort to be all things to all men in order to stimulate their own labors has left its unmistakable mark upon his works. In terms of a distinction which he himself made in the introduction to Nizolius, these include acroamatic and exoteric writings.

> In the *acroamatic* everything is demonstrated, in the *exoteric* some things are said without demonstration, but confirmed by certain fitting and logical quotations, or even demonstrated, though developed only topically and illustrated by examples and analogies. . . . In the exoteric portion one is permitted to luxuriate a little, so that even if some certitude is lost, there is lost no clarity—or at least very little [G., IV, 146].

Among his own papers there are those developed in logical rigor, those in the courtly style with which he sought to interest princes, princesses, and nobles, and those in the personal style of letters to friends. This sense of the diversity of readers also led him to publish his conclusions in different languages and in different journals: Latin in the *Acta eruditorum* for scholars and Scholastics, French in the Paris *Journal des savants* for the intellectuals at the courts, as well as in the *émigré* journals of the Low Countries—Bayle's *Nouvelles de la république des lettres*, Basnage's *Histoire des ouvrages des savants*, Le Clerc's *Bibliothèque universelle*—for Cartesians and other moderns.[19]

For a universal philosophy needed to bring into agreement ancients and moderns, Cartesians and Scholastics, mechanists and teleologists, atomists and subjectivists like Foucher. An adequate faith to serve as the basis of confident action demanded the concord of minds, a goal which challenged Leibniz's diplomatic finesse and in the attainment of which he did not always avoid the skilful exploitation of an ambiguity or of the emotional impact of terms. "I hope," he wrote to Clarke late in his life, "that my demonstrations will change the face of philosophy." Though he refused to compromise irresolvable issues, most of his philosophizing was in a conciliatory spirit; he was usually more aware of the similarities which bound his thought to that of others than of the differences. Among his papers, the basic stratum of reading notes, paraphrases, and preliminary sketches contains studies of Plato, Aristotle, Augustine, the Scholastics, Descartes, Hobbes, Grotius, Spinoza, Cudworth, Boyle, Malebranche, Bayle, Locke, Toland, and Shaftesbury, to mention only those of prominent and enduring place in the tradition. Indeed, his two extended philosophical writings are merely critical comments on the works of others: the Theodicy on Bayle and the New Essays on Locke.[20]

A perennial philosophy, however, must involve a synthesis not merely of the truth found in other philosophers but also of all fields of human investigation and activity. This Leibniz sought to achieve through philosophic construction beginning at two poles, that of method and that of metaphysics—a construction in which unity is achieved through the discovery of general principles with specialized applications to the various fields and the granting of metaphysical status to these principles. The long dispute about Leibniz's starting point is therefore largely futile; his metaphysics is based no more on jurisprudence than on physics, for the same lawgiver is involved in both—and in ethics and theology, in psychology and mathematics, as well. His philosophy seeks the most general principles common to law, theology, and science; whether in logic, psychology, or physics, it seeks the same truths, though under the restrictions of a different set of definitions and symbols, and therefore with more concrete but limited meaning. No other modern thinker has attempted to bring so great a range of subject matter under the rule of so few general principles.

The breadth of Leibniz's cultural goals, of which his methodological and metaphysical studies were but instruments, thus helps to explain the fragmentary and incomplete nature of his work, his extreme caution in considering anything ready for publication, and the general pattern in which his efforts advance from grandiose but purely formal plans to the special investigation of particular problems, particularly after 1690. The universal encyclopedia ended in a series of studies for the logical calculus and the general science; the *Catholic Demonstrations*, in the various metaphysical discourses of the last three decades of his life. It is characteristic of Leibniz that until the age of about forty-five he worked as much as possible on the parts of his great intellectual projects and that he then found what energies he could save from other duties completely absorbed by his answers to new intellectual challenges, such as the appearance of Locke's *Essay*, Newton's *Principia*, and Bayle's *Dictionary*, the three giants of the approaching revolution. Yet, whatever may be said of this distraction of effort, it must be admitted that Leibniz never lost sight of the general issues involved in his detailed philosophical analyses and that his discernment between the important and the trivial was usually accurate.

For it was the lack of time, as well as his own inclinations, that kept his philosophy incomplete. His letters reveal how he devoted to philosophical labors time spent on journeys and periods of illness or occasionally of rest. Nothing seemed ready; to Placcius he wrote in 1696, "He who knows only what I have published does not know me" (Dut., VI, 65). Two revisions of the long *New Essays* exist among his manuscripts, along with criticisms by a number of French correspondents to whom it was submitted, yet Leibniz did not publish it (Bod. LH., pp. 79, 84). He himself described his confusion in many letters.

> How extremely distracted I am cannot be described. I dig up various things from the archives, examine ancient documents, conquer unpublished manuscripts. From these I strive to throw light on the history of Brunswick. I receive and send letters in great number.[21] I have, indeed, so many things in mathematics, so many thoughts in philosophy, so many other literary observations which I do not wish to have perish, that I am often bewildered as to where to begin [to Placcius, 1695; G., IV, 413 n.].

It follows that, although many of Leibniz's interpreters have quarreled about the systematic unity of his thought, he himself abandoned such claims. In 1696 he wrote to Des Billettes:

> My system, about which you express curiosity for some news, is not a complete body of philosophy, and I make no claim to give a reason for everything which others have sought to explain. We must proceed by stages to proceed with firm steps. I begin with principles, and I hope to be able to satisfy most of the doubts like those which have troubled Mr. Bernier [G., VII, 451].

In the first decade of the new century, Leibniz's insistence on the incompleteness of his thought increases; to De Volder, to Locke's patroness Lady Masham, and to others he writes that his philosophy is still merely a hypothesis, thought he holds it to be the most intelligible one so far advanced and therefore presumptively true. Completeness and unity are sacrificed to the task of inciting others to share in the common aim. After careful and repeated revision, Leibniz's papers were circulated among his acquaintances for criticism or, in some cases, submitted for publication. The "discourse on metaphysics," for example (No. 35), was intended not for publication but for the criticism of Arnauld and perhaps of others. This was true too of the Critical Thoughts on the General Part of the Principles of Descartes, the Principles of Nature and of Grace, the Monadology (Nos. 42, 66, and 67), and many others.

As a final factor, Leibniz's philosophy is affected at different periods by the particular special studies in which he is engaged. Of this, the outstanding example is the fading of the logical interest from first place in his thoughts, after the publication of Newton's Principia and Locke's Essay, and its replacement by the physical studies of the 1690's, his abandonment of the theological projects for church union, and his growing interest in English politics, thought, and culture. Beginning with the Specimen dynamicum (No. 46), the universal harmony is pushed into the background and force to the center, the law of individuality becomes abstract and "formal," and the actual dynamic process the concrete and real. The claims of demonstration are weakened and the hypothetical nature of his philosophy emphasized. The eternal chain of being gives way, in emphasis, to the temporal order of progress, so that in his last philosophical statements (Nos. 66 and 67) the Platonic doctrine of ideas on which his thought is always based is not explicit, logic is subordinated to epistemology, while psychology, biology, and history are in the foreground.

III. The Metaphysical Pattern

The intellectual strivings of the seventeenth century find visible reflection in its architectural forms. The great garden at the summer palace of Herrenhausen, north of Hanover, was replanned and extended in 1696 by the Electress Sophia and her garden architect Charbonnier; Leibniz himself served as consultant on the fountains and perhaps on other matters of technology and design. It may have been in its garden theater that the noble actors performed his masque Trimalcion, to the professed scandal of the more ponderously austere court of Berlin. Certainly it was there that he walked with his patroness Sophia and her daughter, Sophie Charlotte, the first queen of Prussia, and discussed the problem of God's plan and man's place in it. It was there that he challenged Herr von Alversleben to find two leaves that were identical in form, yet discernible. In it he found, too, the physical symbol of an adequate metaphysics—universal harmony; individuality without duplication, yet reflecting and re-presenting the order of the whole; dynamism; and to one side the labyrinth, inviting dalliance but never complete understanding.[22]

The Herrenhausen garden was an enormous rectangle, surrounded on three sides by canals, and carefully subdivided, in strict geometrical fashion, into thirty smaller squares isolated from each other by walks and thick, carefully shaped hedges. Each smaller garden was further planned in formal order but with complete variety; no two gardens were alike, for each had its individual "principle" and name. Yet so similar was their basic design that, casually observed, they might easily be confused. Complete individuality was fused with universal harmony. The carp ponds were themselves individualized; gazing into them, Leibniz might well imagine "each portion of matter . . . conceived as a garden full of plants, and as a pond full of fish. But every branch of each plant, every member of each animal, and every drop of its liquid parts is itself likewise a similar garden or pond"—not one of the more fortunate of his figures. At the intersections of the main boulevards separating the newer gardens were fountains, among them one of the highest on the Continent.

The moral order of the honorable man, like the garden, demanded individuality and freedom within the limits of an inviolable order and plan and spontaneity regulated by the universal harmony. Differences in ability, temperament, and environment vary in each individual, determining the limitations in the successive experiences and perspectives in each. But, however different, the individual laws of the separate series follow from the universal harmony which science and the social order seek. It is this universal harmony which provides not only the basis for the honorable man's capacities and actions but also the goal of his moral obligations. Both efficient and final causes are imbedded within it.

Three conceptions, therefore, and their mutual relations, determine the pattern and the problems of Leibniz's philosophy—universal harmony, individuality, and force—and the notions in terms of which he seeks to relate them are mathematical function, representation, and conatus or striving. Universal harmony he derived from the Platonic tradition; individuality from Aristotle and the moderns, but with an idealistic principle of individuation;[23] while that of dynamic change is his own, though stimulated by both Aristotle and Hobbes. Thus his success in reconciling the ancients and moderns is bound up in his success in relating these three determining principles.

1. Leibniz first attempts to interpret individuality and process in terms of the universal harmony. The a priori starting point for his thought is the perfections of God, the universal calculator from whose contemplation and choice of possibilities the world is born.[24] Not the God of Descartes, a Machiavellian prince on cos-

mic scale, upon whose will the order of logic and of nature depends, but the "region of ideas," the inner necessity of whose perfection requires it to bring the best of all possibilities into existence—this is Leibniz's God and the foundation of his system. God is perfect intellect, and his will is merely "a certain consequence of his intellect" (G., I, 257, No. 16; cf. PA., VI, i, 45). The reality of a harmonious perfection is the first presupposition of Leibniz's philosophy.

The full meaning of this region of possibilities becomes more apparent only when the nature of an idea is understood. An idea is a structure of meaning, a real definition, based on the law of identity and contradiction, and in close logical dependence upon the other ideas constituting God's mind. As such it is the possibility of existence, and not merely, as Cassirer's Neo-Kantianism leads him often to imply, of experience alone. Every simple idea is a mode of God's perfection and therefore harmonizes with all other such units in the divine intellect. In terms of the mathematical analogy in Leibniz's system, every idea is a particular solution, in terms of one variable, of a complex functional relationship between the infinity of variables which comprises God's understanding. Before Paris, he thinks of number as that category which reveals this harmony; after Paris, he sees the need of an extension of mathematics beyond number or quantity and a universal logic of relations.

Beyond such mathematical analogy, this harmony of ideas cannot be described, for human knowledge is merely discursive and in symbols, and all description is therefore already involved in a dualism or polarity which the ideas themselves make possible but which they also escape—the dualism of passive content or symbol and symbolic act or active representation. Yet the structure of this realm of possibility can be represented in symbols, and it is this description which provides the foundation for Leibniz's logic, mathematics, metaphysics, and practical philosophy.

The universal harmony and perfection of meaning cannot be proved without a vicious circle, for the principles upon which proof rests are derived from it. But, unless it exists, there is no principle of knowledge, no explanation for anything being as it is. Descartes is therefore right in his use of the ontological argument—though his argument collapses with his failure to prove the possibility of such perfection of meaning. This possibility Leibniz, too, never succeeds in establishing, though he makes great efforts, and for a time professes to have done so, before he drops the argument and returns to the cosmological (Nos. 14 and 16). But, given the existing series of events, there must be some reason for such a series existing and being as it is rather than otherwise, and the quest for such a reason leads to a realm of possibility whose perfection involves all of creation (No. 51).

Three properties of the ideas, which arise from their perfection and plenitude, help Leibniz on with his thinking; he finds in them the basis for logical relations, for process, and for metaphysical individuality.

(1) Every true proposition or every relationship, whether existent or merely possible (Leibniz tends to disregard negative propositions, since he considers them as mere denials of the truth of positive propositions), must conform to the law of possibility or of identity and contradiction. If it does not, it is mere words unsupported by any idea. At once, however, two issues arise in the interpretation of propositions: (i) they may be understood to signify either the extension of individual instances or the intension or essential meaning and (ii) they may be given a relational or a more specific predicative interpretation. Leibniz recognized these alternative possibilities, but his effort to construct a metaphysics of individuality on the Aristotelian-Scholastic pattern made it difficult for him to adopt either a relational or an extensional interpretation. Denotation, being possible only in existence, is therefore logically derivative from the a priori realm of essence and hence also merely the empirical preliminary to the true scientific analysis.

Furthermore, the conception that all being derives from the intellect of God provides metaphysical warrant for the Aristotelian principle that "in every true affirmative proposition, the predicate is included in the subject" (predicatum subjecto inest),[25] a principle to which Leibniz looks for support of his conception of individual substance.

The reconciliation of this logical and metaphysical point of view is the first difficulty in Leibniz's system. The harmony of ideas is one of systematic interdependence, not of the subordination of predicates to subjects or to the substances which they qualify—for Leibniz regards substances as completely analyzable analytic propositions. His logic thus applies the Aristotelian-Stoic categories of substance and property to a field of logical meanings which rather demands the Platonic, mathematical logic of relations. Thus he never clearly relates or sharply distinguishes between forms as attributes of substance and forms as "formulas" or models, as these are developed in his symbolic calculus. The predicative logic should have been considered as a special case of the more general relational analysis, but Leibniz's concern with traditional conceptions of substance kept him from freeing himself from the Aristotelian position.

(2) In the second place, ideas are not merely the basis of logic and its laws; they also have a dynamic quality. "In all essence there is a striving for existence." In the ambiguities of the verbs exigo and conor there lies concealed the secret of the relation of process to structure, power to plan, and will to intellect. It is the fulness and perfection of the ideas which make creative activity necessary; if nothing existed, possibility would not be complete or perfect. Therefore ideas must be powers. And man's internal sense reveals that ideas do in fact have this dynamic quality; human ideas are never separate from the drive to action and perfection. Thus, by analogy, every divine idea tends or strives to exist, except insofar as it is prevented by the striving of other ideas.

How the harmonious possible ideas can interfere with each other in their striving toward existence is the second great unanswered problem of Leibniz's thought. He points to the fact of interference and conflict, of evil and the demand for compensation, in the created world; he acknowledges the sources of his conception in older doctrines; but the reason for it, he admits, is unknown to us (G., VII, 195). If man knew this, he would not be bound to truths of fact or contingent judgments but would know as God knows. In its logical and absolute sense, the law of sufficient reason fails man at this point, and the infinite breach appears between truths of fact and of reason.

Yet Leibniz's effort to reduce the problem to human ignorance is not completely successful, for the paradox is clear for all to see. A realm of harmonious possibilities, comprising the perfections of God, is nonetheless incapable of being rendered existent because of internal inconsistencies. But, when the best of all possible combinations is chosen, the result is an existing order of compossible events in which complete harmony is again the law of the relationships between monads. In terms of possibilities, existence must be relatively disharmonious; yet in terms of the harmonies of existence, the realm of possibility is itself disharmonious.

A partial answer to the paradox is to be found in the nature of time and space. With the dynamic quality of ideas, both of these enter as the new dimensions of existent compossibilities. Here too the mathematical analogy is helpful; a functional law is actualized in a series of particular values, and this series involves infinite and continuous succession. So an idea, or the law of an individual, striving to exist under the dual conditions of its fulness and its limitation, achieves the greatest possible perfection through a succession of changes or states. Leibniz boldly appropriates the term "conatus," which Hobbes had used in a physical sense, for the momentary tendency of a meaning to actualize itself. And actual qualities which, considered as possibilities or essences, would be inconsistent with each other may become consistent when distinguished in space or time. Since space is merely the simultaneity of two or more events, and time is succession, creation requires both in order to achieve the best, or the maximum of possible harmony.

(3) Finally, because creation involves plurality and mutual limitation, it involves a duality of activity and passivity. As every idea strives to "realize"[26] itself in harmony with others, it is distinguishable into a polarity of active forces and of passive content or matter. Within the series of events which result from the ideas as powers, therefore, each existing event is unique yet a part of many wholes, some of them existent, some eternal patterns. Its uniqueness consists of activity, however momentary; its dependence consists in passivity, for which Leibniz revives the controversial term materia prima. In mind this matter is inert content, while the activity is perception, and the differentiation of this activity in successive stages is appetite (conatus). In physical processes the matter is inertia, the activity force. Every individual is thus (i) an idea or law, a part of the divine harmony, (ii) continuously differentiating itself into a series of events which are interrelated (though not interacting) spatially and temporally, (iii) in a succession of impulsions or fulgurations, each of which also involves a passive inert quality reflecting the rest of the world upon which it depends. This passive element constitutes the limitation of the individual or of its "point of view."

Individuals may thus be viewed as differentiated products of the universal harmony of ideas, and natural and historical change as the creation of an existing order after the best of possible plans. And the understanding of existence should be derivable, therefore, from the eternity of God's perfections. But only God can view the universe adequately from this purely logical starting point; for finite beings it is impossible except in abstract or "incomplete" terms, since the ideas are perspectiveless, while we are limited to particular spatial and temporal perspectives.

2. It is therefore more fruitful to shift the emphasis from logical possibility to existence and to view the eternal harmony from the viewpoint of the individual. For both theoretical and practical reasons, it is a primary concern of Leibniz to establish a gen-

uine individuality. Pluralism is required if analysis is valid, for, where there are real aggregates or compounds, there must be ultimate and simple minimal realities, and these cannot be spatial, since spatial analysis is possible beyond any definable limit. The spatial analogue to an individual is a point, but an individual is a "metaphysical" point, one at which something is going on. Here, again, a more convincing argument for the reality of individuals is man's experience of himself as a self-determining and private entity different from others and causally independent of them.

Leibniz's emphasis upon individuality and process increases in the later periods of his thought; though the Discourse of 1686 (No. 35) is the first work to develop his mature conception of the individual monad, it is still centered upon God and his providence, while the Principles of Nature and of Grace and the Monadology, both written in 1714, are built upon the argument for individual substance. His criticism of other systems is often aimed at their failure to provide a firm basis for individual existence (Nos. 53 and 58 are examples). Spinoza, of course, fails entirely, since he recognizes no plurality of active principles in nature and hence no created substances. But even Malebranche has failed as well, since he shows no real connection between the active principle in man, which he limits to the will, and the ideas in God.

Every individual is thus an idea or law fulfilling itself in a succession of active-passive states. Individuality is therefore not determined by matter but rather determines it; only by basing individuality upon the creative ideas themselves can individual and universal be related. To shift the emphasis from the eternal to the temporal, as Leibniz himself tends at last to do, it is within the nexus of perceptions, modifications, or events within the individual that empirical evidence is to be found for the law or the inclusive idea of his individual nature and for the universal harmony which each event reflects or represents. For every passing state of an individual expresses, represents, or perceives the universe according to the restricted limits of its nature or law, so that a complete understanding of any one involves the whole harmony.

Two important applications of this general principle may be pointed out in passing—one to the theory of human knowledge and the other to human values. Knowledge is a special case of the more or less momentary representation of the universe according to a finite point of view. The human mind—man as a body-soul unity is an individual only in a secondary sense—is a true metaphysical unity consisting of a succession of states which fit the harmonious functioning of the many individual unities which comprise his body and, through these, the rest of the universe. The body thus determines the mind's limitations or its finite and imperfect point of view. Any present act of knowledge is related to the past states of mind through the abiding law of the individual given imperfectly in memory; it is also related to the future states of the same mind through purposes determined by the same law. But every present state also consists of some content—sensory, emotional, and, on higher levels of knowledge, symbolic—by which the mind represents the universal harmony more or less confusedly, indistinctly, and inadequately. Leibniz holds that in the act of knowing we begin with a double datum and that we never free ourselves from it—the subjective act and the objective content of perception. Hence interpretation must always involve the belief in a greater reality of which I am a part, independent yet inclusive. "Every mind," he says in a fragment from the Paris period, "is omniscient but confused" (Cout. OF., p. 10). Knowledge is thus a representative act whose content is symbolic of an external reality but whose objective truth lies in its structure and rests on the universal harmony in creation or beyond it in the logical realm of possibility. Truth is verified by the quality of thinking which the mind does with its symbols.

The case is similar with human values. All human goals are the perception of some aspect of the universal harmony. It may be unclear and indistinct or reflective and critical. Pleasure is the subjective matter accompanying the movement of the mind toward objective harmony; pain, the subjective matter representing disharmony, whether within the mind, its body, or beyond it. Thus "pleasure is harmony in a sentient being," "good is contemplation of the ideas," and "the beatific vision . . . is the contemplation of the universal harmony of things, because God or universal mind is nothing but this harmony of things or the principle of beauty in them" (PA., VI, i, 97-98, 474, 496). Value is thus, on the subjective side, based on pleasure, but, since feeling is but the primary matter of an active teleological striving which itself expresses more or less of harmony, value is, on its objective side, a relation to perfection. A genuine individualism thus involves a unique restriction of, but also a reaction to, a universal order.

3. The third general principle which distinguishes Leibniz's metaphysics is the dynamic. Leibniz's interest in force and action is supported by his theoretical studies in physics and psychology.[27] In contrast to Descartes, he stresses the importance of formal operations even in mathematics. Matter is not merely extended, as Descartes held; it involves resistance and therefore action. Mind is not a substance in the sense of an enduring substratum of modifications; it is a succession of active states conforming to law. Force, it is true, does not emerge clearly as a metaphysical principle until the refutation of Descartes's physics around 1686 and the dynamics of the 1690's, at a time when his social interests are also being deflected from the eternal elements of law to history and from the perfect ideal to the process of gradual perfection. Creation is continuous temporal process, and that which distinguishes truths of fact from truths of reason is the essentially temporal nature of their predicates. Leibniz's dynamism is modern and his own, making him a fruitful innovator, particularly in physics, psychology, and the metaphysics of nature; and it is not misleading to find here the point in which modern thought shifts from a domination by extension to a domination by time.

The relation between these three principles—harmonious order, individual substance, and dynamic process—presents the most difficult problems for the student of Leibniz. Interpreters have generally followed their own inclinations in making one or the other central. He himself never reached permanent clarity about them. Bound to the end to the eternal "chain of being," he never succeeded in fully freeing from it the individual and the changing processes of existence, though his appreciation of them grew with the years. His own choice of Scholastic terms, the intellectual mood of the time, and his conviction that experience involves both the changing and the changeless prevented him from adopting, in the end, either a clear temporalism or eternalism, a clear pluralism or monism.

IV. Leibniz's Method

Since he thought of philosophy and science as a social enterprise of which his own efforts were but a part, Leibniz's actual method may well seem at odds with the conception of method which he is generally held to have proposed. He did, of course, propose one and made efforts to apply it. The Scholastics had failed through poor concepts, ill defined (Nos. 3 and 7); his own method must include a rigorous test of real definitions as opposed to merely verbal or nominal ones. Descartes and the followers who amplified his rules—even the great Arnauld in his Art of Thinking—had failed to provide criteria for clearness and distinctness; he would derive such criteria from the laws of logic themselves (Nos. 33 and 39). The empiricists, even Locke, had failed to distinguish the problem of a valid method from the description of a psychological process; "the question of the origin of our ideas and principles," he asserted against Locke, "is not the preliminary one in philosophy, and we must have made great progress before we can well answer it" (G., V, 16).

His own method had two phases—the critical analysis of concepts and judgments into their component parts (a judgment being the process of breaking up or building a complex concept) and the constructive synthesis of truth which represents or expresses reality (No. 25). In his Art of Thinking Arnauld[28] had expounded Descartes's method of analysis and synthesis on the basis of an unpublished manuscript given him by Clerselier; Leibniz identified this method with that of judgment and invention proposed by Ramus. Analysis consists of finding the most simple concepts involved in compound concepts and the most general principles implied in more particular ones; it is therefore equivalent to an internal induction which proceeds from complex given facts or relations to the more general and abstract concepts and principles which are entailed in them. Leibniz generally assumed that the number of primary or most simple notions, once found, would be relatively small and fixed. Synthesis, on the other hand, is constructive, building more concrete truth, possible or existent, out of truths that are simple or accepted as simple. It therefore corresponds in general to deduction, which Leibniz therefore conceived as a process of accretion through new definitions. For truths of reason such a method provides certain truth—provided the principles and notions used are known to be possible, that is, to obey the law of identity and contradiction. For truths of fact, however, possible combinations must be tested and verified by experience, since we lack the power to derive them from completely simple and therefore certain concepts. This is the method of hypothesis. Both analysis and synthesis are thus essential to all knowledge, whether of possibility or of existence; both must begin with facts and principles as well and would ultimately include all facts; both must be in terms of the most fitting symbols available; and both rest upon the same ultimate rational principles: identity, contradiction, and sufficient reason (No. 24, II).[29] For man intuitive knowledge is possible only of the most abstract principles of reason and of such self-evident notions as being, of abstract logical systems, and, in the realm of existence, of himself as the subject of particular experiences; all other knowledge depends on the discursive methods of reasoning.

It has been held by penetrating Leibniz interpreters, notably Couturat and Russell, that Leibniz attempted to found his thought by deduction alone. The view has much to justify it. Couturat found very important, in this connection, the "First Truths," a study from the years between 1679 and 1684 (No. 30) in which Leibniz professes to deduce most of his basic principles—sufficient reason, the identity of indiscernibles, the internality of denominations, continuity, the analytic nature of propositions, and his concept of individuality in general—from the law of identity. Leibniz held, throughout his career, that all propositions are analytic or that in every true affirmative proposition the predicate is included (intensionally or connotatively) in the subject.[30] Therefore, if the elements of all subjects were given clearly enough, deduction would suffice for philosophic knowledge.

Such deduction, however, would itself combine analysis and synthesis, if it were possible for man to carry it out. For it would have to begin with a complete definition of God, which would contain all the simple concepts which are his properties or perfections (G., IV, 425), as well as with the most general principles of thought.

Deduction proceeds from identities and definitions, but with the exception of the definition of God as the most perfect being all definition involves analysis and synthesis as well. In short, Leibniz held that for God all knowledge would be deductive, and his judgments completely analytic, since his knowledge always rests on adequate and complete intuition, but that for man such knowledge is limited to those abstract fields of possibility, like mathematics, formal logic, and abstract ontology, which involve no time and contingency. Most human knowledge concerns the temporal and conditional where analysis and synthesis must support each other, whether we proceed deductively from established truth or from mere hypotheses. Here analysis is still the essential basis of synthesis, whether the concepts to be analyzed are known and the compatibility of their component concepts is to be shown or whether the notions themselves are unverified and the formal analysis of their definitions leads to verifiable abstract parts, thus verifying the concepts themselves. The unknowns of algebra furnish the outstanding example of such "dumb reckoning," as Leibniz sometimes calls it; the verification of a scientific hypothesis is an important application. A concept is necessary if it is implied in the analysis of a known truth. If this necessary implication involves causal inference (from effect to cause), it is contingent or physical necessity; if it involves only the laws of logic, it is metaphysical or logical necessity.

It is synthesis, however, which is the source of new knowledge on the part of man. Every human judgment—we may now restrict ourselves to judgments of fact—involves two mental functions: representation and reasoning. Representation is the function of symbols or characters in knowledge; it is the relation of expressing or standing for an objective state of things. Reasoning (ratiocinari) consists of the analytic-synthetic defining or "formulating" of a structure of symbols in such a way that it can be verified as representing the structure of reality. Successful synthesis involves the choice of "real" characters, symbols qualified by their very structure to reveal the organization of the world in their formulas. Leibniz was aware of the fact that common language contains this "real" element and was concerned to improve it. But science and technology are in a position to develop their own efficient symbols and operations—the decimal system, the symbols of the calculus, or, more recently, the benzene ring are examples of such real characters. It was to develop and to unify these that Leibniz proposed a universal characteristic or science of symbols, toward which the operational symbols he himself developed in logic, geometry, the calculus, and mechanics were but a beginning. Reasoning thus consists in the construction and application to experience of symbols according to an established set of axioms and accepted rules of operation or transformation.

Thus the ideal of a general characteristic becomes a general science in which the principles and methods of all the sciences are generalized. The conception of such a science is one of Leibniz's greatest visions. In addition to the characteristic, this would contain the sets of axioms applicable for any particular science and, derived from them and from the definitions of the symbols, the appropriate rules for transforming the symbolic formulas which constitute the methodology of the science. Every science is thus thought of as capable of general mathematical organization through a general theory represented in a symbolic language by means of an appropriate set of symbols and developed by fitting operations. But the axioms themselves are all special instances of the most general metaphysical principles; for example, geometric similarity and congruence are derivatives, on two distinct levels of completeness, of the law of identity, as are algebraic equations and the principle of the equipollence of cause and effect or the principle of conservation in dynamics.[31]

Thus the ideal of a general science implies in its turn the ordering of the sciences into a hierarchy in which all are related analogically because all involve the same ultimate principles and rest upon the same harmony. Reality as we know it consists of "well-founded" systems of phenomena, each of which is a particular translation of the same unified and ultimate pattern of being. The result is a pattern of analogies, so that physics becomes a phenomenal commentary on metaphysics, the nature of the monad being reflected in the mass and energy of composite bodies. Similarly, physics reflects the same ultimate principles, differently synthesized, as psychology, biology, ethics, and law, all of them (and we should add, though Leibniz did not, theology as well) being partial symbolic representations of the ultimate harmony of being which man can know only abstractly in logic, mathematics, and metaphysics.

Philosophy therefore becomes the most general and universal science, seeking the common principles and common structure of being which all other fields represent from a limited point of view. And its problems center in two foci, that of metaphysics and that of the methodology of knowledge.

It may be well to remind ourselves, in view of the widespread revival today of Leibniz's vision of a unified science, of the limits which he discovered to its development. Three factors are important for the understanding of his own thought.

(1) Human knowledge, Leibniz himself discovered, is more relative and shifting than his conception of method allows. It is true that modern logic does not hold his conviction that, if we could but reach them, the simple notions out of which all being is compounded would be sharply defined, easily enumerable, and all on one level as far as their combination is concerned. His own recognition that in the analysis of existence human efforts to arrive at finality are blocked by man's finiteness points to this conclusion. To anticipate Kant, we may say that such efforts finally confront the antinomies which mark our knowledge of existence—those of finiteness and infinity, plurality and unity, activity and passivity, change and permanence.

(2) Leibniz's own failure to apply his own method perfectly illustrates this. It is true that his papers contain many successful applications of the method of analysis and synthesis, but, except for his logical studies, his approach to philosophical problems was relative to experience and applied the method only within empirically applicable limits. Excellent examples of this are the physical studies in Nos. 15 and 32. Thus he generally uses a twofold method. His dynamics was written from both an a priori and an a posteriori point of view—treating motion, and later force, abstractly and concretely (Nos. 8 and 46). In law he attempted both the casuistic and the formal and normative approach. No part of experience escaped his scrutiny—on the subjective side joy and sorrow, dreams and the confusions of sense, the orderly processes of memory, association, and thought, claims to the beatific vision; on the objective side, everything from stellar relations to the microscopic cells which Leeuwenhoek showed him, and from the impact of colliding bodies to the problems of architecture and other arts, and the hidden harmonies and collisions of social order. Yet his rationalistic assumptions protected him from falling into the

empirical confusion between simple enumeration and induction, origin and validity, while his wide interest in facts received at least a formal unity from his search for the general principles of an exact scientific instrument.

(3) Finally, metaphysics, though abstract, receives analogical support from one empirical source of knowledge that escapes the symbolic and representational character of the rest. This is man's experience of his own mental processes in reflection or the internal sense, or, after 1700, "apperception." Self-awareness of this immediate kind is the only concrete intuitive knowledge which man possesses and proves adequate to penetrate into the deepest levels of the soul and to reveal the enduring nature of its thought and desires; if analogies are based on it, it provides the most concrete clue to an explanation of the metaphysical categories or the simple perfections of God.

> In whatever sense they are taken, it is always false to say that all our concepts come from the senses which are called external; for the concepts which I have of myself and of my thoughts, and as a result of being, of substance, of action, of identity, and of many others, come from an internal experience [1686; No. 35, Sec. 27].

> The immediate apperception of our own existence and our thoughts provides us with the first truths a posteriori or of fact, as identical propositions contain first truths a priori or of reason, that is, the first lights. Both are incapable of being proved and can be called immediate, the former because there is immediacy between the understanding and its object, the latter because there is immediacy between the subject and the predicate [after 1704; G., V, 415].

Thus the nature of the scientist himself, as given in immediate experience, throws a more concrete light upon the metaphysical implications of his work.

V. Logic and the Principles of Truth and Reality

The problem of the relation of Leibniz's logic to his metaphysics is crucial in the criticism of his thought. It does not belittle the excellence of Russell's and Couturat's work to say that their efforts to show that his metaphysics is built upon his logic, though not soundly, have been refuted.[32] Leibniz shared the Aristotelian and Scholastic conviction that logic is a tool of thought, that it is a science of relations only as these are thought, and that it must be grounded in the universal, self-differentiating harmony which is reflected imperfectly in individual substances. His logical studies aimed to provide the instruments by which man can grasp the structure of being in his own symbolic formulas. They were devoted, first, to the perfection and reduction to mathematical form of the Aristotelian logic, which he used most skilfully on occasion, and then to the development of a more universal logic built upon mathematical symbols, operations, and axioms. This logic was to become the instrument of his universal science.

As has already been shown, however, there is a difficulty in adjusting Leibniz's logic to his metaphysics, which corresponds to the difficulty he found in adapting Scholastic terminology to functional modes of thought. Its source is to be found in his theory of the proposition. His problem was to generalize a logic of the subordination or inclusion of meanings into a logic of symbolic forms and then to make this fit both metaphysical dynamism and metaphysical pluralism. In none of these tasks was he successful.

The structures of classical logic consist of terms, propositions, and syllogisms. Interpreted in terms of symbolic relations, however, these become formulas, relations, and operations—logical entities which are more relative and interchangeable than the traditional concepts. The operations of logic are for Leibniz processes of climbing the scale of being from less adequate and complete to more adequate and complete concepts or constructions or, to use the terminology of 1686, from partial to integral concepts. But with this conception the notion of the proposition with which Leibniz begins is not completely compatible.

In his opinion, all knowledge implies the identity of the complete predicate with the complete subject. Identity is therefore the basic principle of possible knowledge, whether of fact or of reason. Operationally, identity is defined by the possibility of substitution;

two terms are identical if one can be substituted for the other without distortion of meaning. If they cannot, the reason is either contradiction or inadequacy. Contradiction, therefore, or the principle of impossibility, is implied in identity, and the two are opposite aspects of the same law, which Leibniz sometimes calls the basic law of being. The principles of equality in mathematics, of congruence and similarity in geometry and mechanics, and of equipollence or equivalence in dynamics are particularized special cases of the general law of being upon which all truths of reason and the a priori components of truths of fact depend.

The principle that the predicate of every affirmative proposition is included in the subject is therefore the most general logical consequence of the law of identity.[33] But Leibniz uses it also to express the ontological unity of a substance and its modifications. Since this principle is important for his argument to individual substance, the logical qualifications which he places upon it must be clear.

In the first place, the relation between predicate and subject must be understood intensionally, not extensionally. Extensionally the relation would be reversed, and the subject included in the predicate. Leibniz recognized both points of view and even discussed the rules for conversion from one to the other, but his own metaphysics of harmony required the intensional interpretation. "All A is B" means always that the properties of A, or the simple notions contained in it, include those of B. In the second place, he recognized that there are human judgments with particular subjects of which this is true only implicitly, not explicitly. Thus human judgments are synthetic, taken empirically, though their analytic nature would become explicit if both subject and predicate were further reduced to their simpler components. Thus "Some A is B" means that there is among the simple notions included in A at least one that is also included in B, so that, calling this C, the particular proposition reduces to the two universal ones: "All A is C" and "All B is C." This fundamental logical principle, which

Leibniz had some success in defining for the special cases of universal and particular affirmative categorical propositions, is the logical unit in terms of which he undertook to reveal the structure of meaning and existence.

The central issue in Leibniz's metaphysics may be put logically in the question whether an individual substance can be identified with a complete or "integral" logical subject or whether it is merely "partial" or incomplete. In Scholastic terms, he correlates the basic logical proposition, _predicatum subjecto inest_, with the ontological one "All modifications are of subjects" (_Modificationes sunt suppositorum_), both of which he ascribes to Aristotle,[34] a correlation which entails the third principle that "there are no purely extrinsic denominations." These three principles converge to support his view that every completely analyzed existential proposition would have an individual substance as subject. But though he introduces a number of devices to support this possibility of logical reduction to substantial individuals, notably the distinction between _direct_ (_recto_) and _oblique_ logical relations, he does not succeed in showing that, as particular propositions can be analyzed into more inclusive universal propositions, these in turn must be referred to propositions with singular and concrete subjects. His mathematical analogies throw more light upon this metaphysical problem than does his logic.

It may be added in passing that, besides the law of identity, the law of sufficient reason is also involved in this theory of the proposition. A reason for every predicate must be found in the complete subject (analytically), and, conversely, each predicate serves as partial reason for the complete subject (synthetically). When analysis is adequate, logical propositions will have substance as subject and its properties as predicates, or, using the mathematical analogy, an individual law as subject and its implications, universal or particular, as predicates. The proposition, therefore, which defines a complete concept or the concept of an individual must, Leibniz believes, have as its subject an individual substance, and as its predicate all the simple notions which determine the concrete individual but which include the universal harmony in which it is based.

Definition is thus the logical form in which knowledge most completely expresses the principle of identity and of being. As ideas are a higher form of being than natural processes, definition is a higher form of knowledge, for Leibniz, than scientific law. Since the ideas are dynamic, definition reveals not merely the structure of possibility but the processes of existence as well. In human knowledge definitions are of three kinds; if merely verbal, they are arbitrary and express the relation of symbols to meanings only, and the test of their adequacy is the substitution of definiendum for definitum. In themselves verbal definitions signify nothing about reality, and their use is purely structural within restricted levels of discourse. Leibniz held that Hobbes's logic had failed to establish his metaphysics because he recognized only verbal definitions. Nominal definitions are real, but their predicates contain qualities sufficient to identify their subjects. Descartes's basic argument was vitiated by his failure to establish the possibility of his definition of God by the compatibility of the simple predicates it contained, perfection and being, and his definition remained merely nominal. For a real definition must contain in its predicate those essential concepts which serve to determine all the properties and modifications which are involved in the substance which its composite subject represents; Leibniz sometimes calls these essentials determinants. These are the simple, primary essences or concepts, ultimate perfections of God, out of which concrete substances come into being, since all other qualities, essential or temporal, arise by combination from them. In this sense a real definition is operational and explains the individual subject in terms of predicates which involve the entire universal harmony in which they are based. Paradoxically, Leibniz himself failed to establish a priori the possibility of that concept on which all the rest depended and to prove which he developed his theory of definition—the concept of a most perfect being.

The general logical principles on which Leibniz tries to base his metaphysics are thus Aristotelian. His use of the traditional logic was skilful and in some respects original. He used traditional syllogistic structures most ably in controversy and exposition; two notable examples are his letter on dynamics to Papin in 1691 (GM., VI, 204-11) and the summary of the Theodicy in logical form (G., VI, 376-87). He derived the methods of immediate inference and the valid modes of the categorical syllogism in various ways, notably by his own method of regression (à rebours), later also used by C. S. Peirce, and developed both the Eulerian circles and a linear symbolism for portraying relations in inclusion. He skilfully defended the traditional logic in a letter to Gabriel Wagner (No. 48). But his search for a "sublimer" logic, more universal and useful, overshadowed these more traditional interests.

This was the "logical calculus" for which so many studies are found among his manuscripts, very inadequately represented in Nos. 24, 26, and 41. For his symbols he turned to mathematics and language. In certain studies he tried to lay the ground for a universal logical language, both oral and written, whose syntax should make correctness of thought inevitable, and which might become an agency for scientific communication and cultural universalism. But the mathematical analogy compelled his deeper interest and more enduring efforts, since the symbols here were not to be merely arbitrary, as in language, but real—in the same sense that real definitions differ from verbal. Like the symbols of the calculus, they were to lead to the operations from which truth should emerge. Of this logical calculus, the methods of ordinary algebra, the new infinitesimal calculus, and the pure geometry of situation (Analysis situs, Nos. 27 and 70), were merely separate and specialized applications.

The success of Leibniz's studies in the universal calculus was by no means final but consisted rather in the fruitfulness of his individual insights. He was persistently led to think of numbers or, when the elementary notions were unknown, of letters as logical symbols. Prime numbers were to represent simple or primary notions, compound numbers more complex notions, and the processes of multiplication and division (or addition and subtraction) were to suffice for the construction of logical formulas. As these limited concepts proved inadequate, he extended his understanding of logical operations, but his invention was most fruitful when he abandoned arithmetical operations for the direct relation of inclusion (No. 41). Couturat has studied the phases through which his experiments passed, without, however, developing their relations to his metaphysics. It must be said that, the more general and relational Leibniz's logical studies become, the more clearly they appear as abstractions from the universal harmony and system of representations or mathematical functions of which his universe consists and the less they help to determine the individual substances on which he insisted. It is not surprising, therefore, that he was always inclined to move back from the relational and combinatorial logic, which applied both within and between compound substances, to the logic of predication, which he hoped would establish the existence of individual substances.

To this point Leibniz's logic is general and applicable to truths of reason and of fact alike or to the realms of both possibility and existence. But, except for the formal analyses of mathematics, logic, and metaphysics, human reason is limited to truths of fact, which involve not the enduring essences of substance but its changing accidents. Existence is the result of the restricting creative act of God in choosing the best possible of all possibilities; man's knowledge of existence is limited by his spatial and temporal point of view, with the indistinctness and inadequacy of perception which these involve. One of Leibniz's most distinctive achievements is his effort to adapt his logic and the rationalistic principles on which it rests to the realm of existence and change. He does this by using the concept of infinity to bridge the gap between essence and existence and by reformulating the law of being and the law of sufficient reason to apply to temporal events.

The fundamental law of existence is temporality or succession (Cout. OF., pp. 19-20). Judgments of fact involve contradiction, as Parmenides saw, because they involve change. But these contradictions can be removed by reference to time. Applied temporally, the general law of sufficient reason is transformed into the principle of mechanical causality, which Leibniz defends as adequate for existence. Thus for example in the proposition, "That spruce tree is living but will die," temporal reference resolves the contradiction. "A hedgehog has girdled or is girdling it": this is a sufficient reason for the death of the tree. Therefore, "the act of the hedgehog is causing the tree to die." Mechanical causality is thus temporal in its form, empirical in its content, and abstract or "partial" in its result. Such causal judgments are therefore capable of symbolic representation, but since they are contingent, based on selected external relations between events and not on their internal nature, they are merely probable. It is true that, if we could analyze all the causal dependences, we should arrive, empirically and analytically, at simple essences and, synthetically, at the laws of the individual series of perceptions (monads) involved and therefore at the mind of God. But this is impossible because there is an infinity of monadic representations, and therefore of contingent relations, involved in the death of the tree, and thus such reduction would involve infinite stages of analysis. Since we cannot free ourselves from the relative and inadequate representations to which we are bound, scientific analysis is an endless task, and the notion of completely analyzed identities or laws of serial order for every individual in the tree and the hedgehog is merely a scientific ideal, not its method.

In Leibniz's most active logical thinking, however, he recognizes a mediating form of knowledge between truths of reason and truths of fact. This middle knowledge[35] is primarily God's; it is the logical process by which a particular order of events actually comes into existence from the order of possibilities in God's mind.

To be specific, it involves the logic of the "subordinate regulations," or the laws of nature, and their relation to the more general logical principles of possibility. This middle knowledge is, of course, infinitely removed from our analyses. But we have a formal analogy to the process in the problem of maxima and minima in calculus, in which optimal and unique principles are determined from among an infinity of ambiguous possibilities by a kind of mathematical economy. As a definite instance of this process Leibniz undertook to derive the laws of refraction and reflection as a problem of maxima and minima (No. 50), a demonstration which led to the celebrated controversy on the principle of least action in the next century. The principle of the best possible is therefore not merely a pious assumption but a principle of mathematical necessity, which provides a telic element in our scientific methods and principles. It rests on the perfection of God and the limitation necessary in a spatial and temporal order. Since not all possibilities can be actualized, the best possible compossibles will exist, that is, the greatest possible perfection with the least qualifying conditions. Its logical formulation is the principle of parsimony: that explanation is best which produces maximal results with minimal assumptions. The principle of conservation is a physical derivative. Every scientific law or subordinate mechanical regulation is thus the best possible of an infinity of possible rules, and the mechanical causes of nature must be completed, ideally, in the final cause of universal perfection. Similarly every individual cannot contain all possibilities; this would contradict his finite point of view. But he can and does contain the best possible experiences or events, consistent with his dependence upon the order of other existing beings and the universal harmony. This constitutes his purpose.[36]

The three levels of knowledge are thus made evident, and the logical principles on which they are based formulated—truths of reason or of possibility, resting on the law of being and of sufficient reason; truths of fact or of contingency, resting upon the principle of individuality, on time and (phenomenally), on mechanical causality; and the middle knowledge, resting on the law of maximal determination or the best possible. Beyond these generalizations, the relations between the levels of being and of knowledge are concealed from man in the two labyrinths—infinity and freedom (No. 29). These are the labyrinths which separate the upper garden of essential truths from the lower of contingent truths. Man's freedom, which consists in his spontaneity, or the logical principle that all his modifications follow from the law of his own essential nature, or that his predicates are included in his essential subject, is freedom from external mechanical contingency only but not from logical determination or from self-compulsion. If our analysis could proceed to infinity, we should see how his inquietude, his appetites and perceptions, his point of view, though logically implicit in his substantial nature, are all rooted in the universal harmony as well. We are free only because the events which constitute our individuality flow from the law of our nature, but both are rooted in the perfect logical necessity of God's plan—our individual law through the principle of the best possible, and our particular perceptions through the functional relations by which they represent the universe. The inadequacy of this notion of freedom will be apparent in the discussion of Leibniz's theory of error and his ethics; he himself sought to render it more acceptable by the practical distinction between an order which necessitates and one which merely inclines.

The fundamental difficulty with Leibniz's logic is thus the question of whether it allows a genuine pluralism and individualism or whether logical analysis and synthesis, if carried out completely, can end only in God and his simple perfections. That his final answer must be considered ambiguous and inconclusive may best be shown by a reference to his difficulty with relations. It has become commonplace to interpret his doctrine that there are no merely extrinsic denominations as supporting the internality of relations in one or more of the many meanings of that obscure theory.

But denominations, or modifications as observed by the mind, are not relations, though of course they involve relations, and Leibniz himself was inconsistent on the significance of the general relations used in his new calculus. Thus he writes to De Volder, in April, 1702, that "there is no substance which does not involve a relation to all of the perfections of all other substances whatever" (No. 55, V), which, together with his belief that substances are the composites of their modifications, would imply relations internal to the perceiving substance, at least. Yet to Des Bosses, and on many other occasions, he made a distinction like the more recent one between relations and relational predicates: "My judgment about relations is that paternity in David is one thing, sonship in Solomon another, but that the relation common to both is a merely mental thing whose foundation is the modifications of the individuals" (No. 62: letter of April 21, 1714).[37] His distinction between duration and extension as attributes of bodies, and space and time as relations perceived outside of things, is similar (see No. 71, the fifth letter to Clarke).

We may conclude that Leibniz clung to the predicative viewpoint in logic in the belief that it provides the logical grounds for a plurality of logically composite but metaphysically simple substances, while the more abstract relational position does not, but that he did not succeed in escaping the monistic implications of his own logic. The real motives for his pluralism are to be found rather in physics, psychology, and ethics.

VI. Mathematics and Philosophy

It is psychology and mathematics that provide Leibniz with his chief sources of analogy to the metaphysics of existence. From the former he drew his insight into the internal nature of monads or individual series as perception and appetite. In his own great discoveries in the latter field he found an analogy to the problem of the relation between monads, which his logic had not sufficed to make clear, and further light on the nature of individuals. Three concepts essential to his infinitesimal calculus, particularly, provided clues to the relations of individuals, to the universal harmony, and to each other. These were the conceptions of mathematical function, continuity, and the infinite.

Like other scientists of his century, Leibniz was impressed by the adequacy of mathematical knowledge and was convinced that the achievements of the age confirmed the long tradition that mathematics is the grammar of nature. Particularly after he himself had succeeded, by the invention of proper symbols, in solving both the tangent and the quadrature problems within two weeks of each other,[38] his conviction was clarified that "real" characters and the formulas based upon them have both operational and representative meaning. Analysis by determinants and the use of series in the solution of transcendental problems in algebra supported his belief that there are hidden but effective symmetries within the apparent wholes of experience. He placed great weight upon the binary number system which he himself invented, not only because it revealed fundamental relationships in the number system, but because it seemed to have value as a symbol of creation—by One out of nothing. The mathematical investigation of probability, then being rapidly developed, also seemed significant to him, not merely for the promise it gave of making casuistry more exact in law and morals, but because it offered hope of extending the functional viewpoint of mathematics from merely formal and a priori considerations to truths of fact and existence.[39] It is not surprising, therefore, that he should not only seek generalized mathematical symbols and operations as the basis for a universal method but also find in mathematics an abstract clue to the solution of the problem of relations and, specifically, the relation of universal to particular.

The mathematical analogy results from the concept of mathematical function which Leibniz developed as the basis of his calculus. Though the term itself, in its modern meaning, is late in his writings, the idea is present from the Paris period on and underlies the general theory of expression or representation which he first formulates in this period.[40] Viewed functionally, an equation is a "formula" or law of order which expresses the continuous dependence of one variable upon one or more others. A variable, in turn, is the symbolic representation of a continuous series of particular values determined by the relationship expressed in the law to corresponding values of the other variables. The same relationship can be expressed or represented geometrically in a curve or other figure, depending on the number of dimensions or variables, and the number of defining relations between them given in equations. If these defining relations are inadequate, there remains a parameter, and the law of the series is incomplete, defining not one case but a family of cases. A functional equation may be solved for any one of its variables in terms of the rest, and each such solution is a distinct equation defining an individual series in terms of its relations. Every particular value of the dependent variable, moreover, contains a factor determined by the corresponding simultaneous values of the dependent variables; it is thus a unity of abstract relations. But every particular value is also a transition between those preceding and following it in the same series. Thus every functional relationship can be represented by as many laws or equations as there are individual variables and by a complex but harmonious and exactly defined quantitative dependence; each variable expresses all the rest in a series of values following from its equation.

The existing universe may by analogy be regarded as a harmonious functional relationship between an infinity of variables. Each solution of this complex relationship for one variable constitutes the individual notion or law of the individual series. The individual which it determines, and, indeed, whose primary entelechy it is, consists of a series of values, each of which is a transition between the preceding and succeeding values, and each of which represents the corresponding values of all the other variables or individuals involved in the universal harmony. Individuals are therefore serial processes, the continuous expressions of universal laws, but also continuously expressing the infinity of other individuals bound to them by the general harmony.

Leibniz carried the analogy much further, however. Curves are not necessarily linear but have inflections, maxima, and minima. Such inflections from internal causes suggested to him the analogy to internal determination, whether conscious or unconscious. Without such control, action would at every point be linear and tangential. There are levels or depths of functional dependence within any individual series, and these are implicit in every particular value. Thus the differential or rate of change of the variable is a derivative of its idea or law; in physical motion this is quantity of motion or momentum, mv, as opposed to quantity of force or living force, mv^2; in mind it is the momentary appetite or affective drive. On the other hand, the integral is the sum of all values within definite limits; in physics this is the total energy of a physical system in motion; in psychology it is the concrete person, in contrast to the law of the individual or the abstract essence of his nature on the one hand, and, on the other, his varying modes or experiences.

This mathematical analogy obviously breaks down at points. It offers no adequate clue to the finiteness or limitation of individuals—no reason why some individual series reflect the universe only blindly and narrowly, and others more or less materially and more or less unclearly and inadequately. It does not involve the essentially temporal nature of metaphysical individuals or monads; indeed, it is the timelessness of the concept of mathematical function and series that drove Leibniz to emphasize the relative and phenomenal nature of space and time, which are therefore involved only in special and concrete cases of the more general logical nature of logical predicates or modifications. Yet the analogy offered Leibniz his ultimate solution of the problem of physical causality—functional dependence—and particularly of the problem of the mind-body relationship.

It is in terms of this functional system that he defined continuity and infinity. The principle of continuity he generally stated in relation to the process of expression or representation existing between two or more series. It is only in this application that the principle can serve as the tool for criticizing mathematical and physical theories. *Datis ordinatis, etiam quaesita sunt ordinata*. As the known variables are ordered, the unknown variables are also ordered; to every value difference in the independent variable, however small, there corresponds a value of the dependent. This principle becomes Leibniz's criterion for testing mathematical and physical theories (Nos. 34, 37, 42, 46, etc.); it also provides the reason why finite knowledge can always approach but never attain the continuously varying processes of existence. For there is within existence a multidimensional infinity. There is the infinity of extension in time and space, which Leibniz generally treats as a fiction, or describes merely as indefinite, insofar as numbers cannot be assigned to it. Likewise he also calls a numerical infinitesimal a fiction (Nos. 54, 56, etc.). But there is also the infinite involved in the possibility of endless analysis of the continuous finite. For every finite series involves infinite differentials; there are differentials of the first, second, and *n*th order and integrals similarly infinite. So too every perception involves an infinity of representative elements corresponding to the infinity of God's thoughts and their monadic expressions. Such infinity is a necessary consequence of the law of sufficient reason and the principle of plenitude or perfection, since no reason can be given for any finite limit. He writes in a note for a letter to Des Bosses:

> There is a *syncategorematic* infinite or a passive power having parts—namely the possibility of further progression in dividing, multiplying, subtracting, and adding. There is also a *hypercategorematic* infinite or a potestative infinite, an active power having parts eminently, as it were, not formally or actually. This infinite is God himself. But there is no *categorematic* infinite, or one actually having infinite parts [September 1, 1706; G., II, 314 n.].

That is to say, Leibniz does not hold that there are real infinites and infinitesimals in existence, as Russell interprets him; they are in existence only as possibilities of analysis and synthesis. Real infinity is only in the realm of possibility and in God, whose thought supports the possibility of endless processes of analysis by which finite minds would have to attain him. Infinity is thus not the simple boundless and undefined of the ancients; it is the eternal quasi-mathematical perfection of God, variously symbolized but never intuited by finite minds. Swift's parody,

> So naturalists observe, a flea
> Has smaller fleas that on him prey;
> And these have smaller still to bite 'em,
> And so proceed ad infinitum,

does indeed reflect the remarks in some of Leibniz's popular expositions of his thought. But such phenomenal notions are but analogues to the infinity of process to which mathematics give a purer expression. A better example would have been to imagine a complete logical analysis, beginning with the mechanical, involved in the benzene ring or in the representation of sodium by a certain set of lines in the spectrum.

VII. Physics and the Realm of Nature

If Leibniz's mathematical concepts suggested the answer to the metaphysical problems of the relation of individual to universal and of change to permanence, it is his physics that gave his philosophy the more definitely empirical and temporalistic direction which it assumed toward the end of the seventeenth century. For it is in his physical writings that he first sharply distinguished his own conception of force from the merely formal power of the Aristotelians (No. 45).

Both atomists and Cartesians had been impelled by the new discoveries of science to separate the physical world from the order of spirit—the two realms which both Platonist and Aristotelian had held firmly together by the same principles of organization, the forms or ideas. In his youthful walk in the Rosenthal, Leibniz had decided for the new mechanism, but he probably never rejected the necessity of mind as the source of activity and purpose within nature itself. His first interest in the problems of physics themselves arose in Mainz out of two theological problems: the need to analyze motion to prove the existence of God and the need to analyze corporeal substance to prove transsubstantiation. Both motives impelled him to take a realistic view of physical things but to stress the continuity of physical processes with mental and the inseparability of mechanism and purpose (Nos. 3; 5, II; 8; 10). It was the Academic skeptic Foucher at Paris (No. 11) who forced him to consider the claims of phenomenalism—claims which led him eventually to a distinction between "well-founded" physical phenomena and their metaphysical foundations, to a relativistic interpretation of physical motion, and to the distinction between force and motion.[41] At the same time began his penetrating criticism of Descartes's conception of matter and motion. Finally, it seems to have been Newton's *Principia*, which reached him in Italy around 1690, that moved him to attempt a systematic formulation of his dynamics (Nos. 42, 43, and 46), and the differences between his views and Newton's are the subject of the correspondence in progress with Samuel Clarke when Leibniz died in 1716 (No. 71), though Clarke's theological interests prevented the argument in these letters from being restricted to physical problems.

In this long development the pattern of Leibniz's thinking remains largely the same, though some internal inconsistencies are removed and refinements added. Motion is reducible to *cônatus* or impulsion, and, though he at first considered a conatus as momentary motion, he later regarded it as momentary force, which mediates between the metaphysical source and the resulting motion. Corporeal bodies, too, are phenomenal results, not of geometric relations or of mere properties of permanence and impenetrability, but of metaphysical points or centers of force resulting from laws. An inorganic body is but the aggregate of such serial forces, appearing in their interdependence to a perceiving mind as spatial and temporal. Thus the dynamic function of the harmony of ideas appears as physical force; its passive correlate, as mass or resistance. The principle of identity reappears in the equipollence of expended force and work done in a physical transaction or, more generally, in the conservation of force (No. 34, etc.), while the law of sufficient reason becomes the principle of mechanical interpretation. Thus the analogy from metaphysics to physics is in outline complete. Physics is always regarded as a subordinate science which corroborates theology, but one which can be established empirically and independently of metaphysics as well and which concerns a real order of creation, the realm of nature appearing to sentient beings as the physical world.[42]

Like space and time, the orders in which man perceives simultaneous and successive events, motion is relative to observation. There is no possibility or need, within physics itself, to establish an absolute space, time, matter, or motion, for no absolutes are found in the quantitative relations of force, and the result is always the same when a system of bodies in motion is measured, regardless of which particular body is chosen as point of reference. Measurements of motion are exactly analogous to real definitions; just as different real definitions of the same subject are possible until ultimate simple notions are reached by analysis, so many different measures of motion are valid, and that system of reference is to be chosen which is best fitted to the particular problem being investigated.[43] Yet, whatever system is chosen, the quantitative relations will be the same, for physical invariants are not material but mathematical and logical. The reals in physics are functional relations of force, and these appear to our reason absolutely when we have adequate ideas, while bodies and observed motions are relative and variable.

It is at this point that the Leibnizian and Newtonian conceptions are at greatest variance. Russell has rightly pointed out that Leibniz himself obscured the issue between them by confusing the problem of the absoluteness of matter and motion with that of action at a distance, which, like the Cartesians, he rejected as a miracle, though it was probably more compatible with his own theory of physical relations than with Newton's materialism. In any case, the difficulties in both opinions are still real, and physicists have by no means become unanimous in their approval of one or the other, though the mathematical harmonies developed by recent microphysics, on an energistic and relativistic basis, seem to support Leibniz rather than his distinguished adversary.

Leibniz's further analysis of force must be traced in the writings of the 1690's in which his most advanced thoughts were developed. As derivative force, it is the physical correlative of the impulsion of the ideas to act and is thus "better founded" than motion, and certainly than the merely phenomenal properties of inertia and impenetrability manifested by bodies. The dual aspect of the ideas, active and passive, is therefore conveniently reflected in force, which manifests itself actively in different integrations as solicitation *conatus*, *momentum*, and *vis viva* (ma, mv, and mv^2 in aggregate bodies), while its passive pole, *materia prima*, appears as inertia and impenetrability in an aggregate body. Both active and passive force, in turn, therefore appear as primitive and derivative forms, and it is their derivative or secondary aspects which are manifested in physical phenomena as impulsion and matter, respectively. Active primitive force or power is metaphysical; Leibniz also calls it entelechy, substantial form, and soul. Its basis, however, is ultimately the idea, the law of the individual series, or the possibility which determines a particular series of impulsions. Primary passive force, on the other hand, is *materia prima*, the momentary inertia of any unitary being as acted upon, which, when found in a composite body, becomes secondary matter or derivative passive force—the properties of inertia and resistance in the impact of bodies.

From these fundamental relations, together with the principle of the conservation of force—that in any system of moving bodies the sum of mv^2 is a constant—there arise three further principles of conservation in colliding bodies. If a and b are bodies whose velocities before collision are v and y, respectively, and after collision x and z, respectively, (1) relative velocities are conserved ($v + y = z + x$); (2) quantity of progress is conserved ($av + by = ax + bz$); and motive action is conserved ($av^2 + by^2 = ax^2 + bz^2$). These relations, Leibniz holds, can be established a posteriori through experiment but also a priori through derivation from the principles of continuity, sufficient reason, and equipollence.

On the nature of physical bodies, however, Leibniz seems never to have achieved an ultimate unambiguous solution. Space and time being the forms of corporeality, a body (as secondary matter) seems on first appearance to be a bounded space filled with homogeneous qualities, which may be at rest or in motion. But such a body is both materially and mathematically divisible and hence not a true individual (at least as far as its temporal and spatial dimensions are concerned) but an aggregate. As the second proposition of the *Monadology* puts it, "There must be simple substances because there are compound, for the compound is nothing but an aggregate of simples."

Such analysis reveals the incorrectness of both Cartesian and atomic conceptions of matter. On the one hand, there is no sufficient reason for stopping such analysis short of what is further indivisible, and such an indivisible part is, mathematically, a fiction, a continuum is not composed simply of points. To attempt to stop with indivisible but extended atoms is logically inconsistent and fails to explain cohesion, rigidity, elasticity, and related phenomena, since the concept of an atom presupposes them. Contrary to Descartes's view, again, matter includes more than mere extension, since it may occupy different spaces, may change its situation with respect to the same space, and possesses the properties of impenetrability and inertia. The results of analysis are therefore not merely geometric points but metaphysical points of force, to understand which it is necessary to enter the temporal dimension.

The phenomenal body is the continuous representation, not only of momentary simultaneous states, but of successive momentary forces or conatuses. Such units of force explain not merely the continuity of a body, which is phenomenal; they explain also the impenetrability and inertia of apparently rigid composite bodies and their elasticity in impact.

Leibniz's proper answer to the question of the unity of a material mass in gross perception is therefore that such unity is merely phenomenal but is the result of an underlying real harmony of functional relations between many force-point series or naked monads, perceived indistinctly by a mind. As a spatial and temporal whole, but no more, a body is phenomenal. As a plurality of active forces and their mutual resistances, it is a real creation. On the level of uncreated being it is determined by a harmonious pattern of mathematical laws or ideas. There is therefore no unity in body apart from the laws which produce it; all other unity is imparted by the limited purposes of perceiving minds. This is in fact the explanation with which Leibniz contents himself in his compact expositions to Cartesians and courtly friends.

But, from the very beginning of his thought, this explanation is supplemented—and, some would hold, opposed—by another which seeks to avoid the phenomenal nature of bodies and to ascribe a metaphysical bond of unity to them. The motive for such an effort was theological; the doctrine of transsubstantiation as formulated by the Council of Trent required a real body (No. 5, II). For some years during his stay in Paris, Leibniz seemed inclined to accept the Cartesian dualism, thus retreating from the more advanced position of his physical writings of 1671 (Nos. 8, I, and 10). In the discussion with Arnauld in 1686 and 1687, and frequently later, he seems to think of every body as dominated by a unifying soul or monad; certainly he assigns a body to every monad. But he also frequently holds that only living organisms, including rational animals, have such a dominant monad. And in the discussion with the Jesuit Des Bosses (No. 63) he returns to the late Scholastic notion of a substantial chain (vinculum substantiale) binding the monads of a body together. This theory has been explained away as an effort on his part to adjust his theories to Jesuit thought by a conception which he himself did not accept, and the tentative quality of his language does much to support this interpretation.[44] It has also been interpreted as a definite movement of Leibniz's thoughts back to realism and to Scholastic sources.[45] As the correspondence develops, the substantial chain appears to be both an active and a passive principle, added to the monads yet inseparable from them, subject to natural law yet above it, like a ruling monad yet not monadic in structure, and at length a law of organization. Finally (August 19, 1715), Leibniz states his own preference for a phenomenal view of body. Appearing at a time when he is concerned with the individual rather than the universal, with change rather than eternity, and with freedom rather than logical necessity, the notion of a substantial chain may well express his own desire to provide a realistic interpretation of naïve experience. But the interpretation most consistent with his system must regard the substantial chain as a principle of organization, a lesser harmony or secondary complex of individual laws, as it were, within the greater harmony of God's creative plan.

That the mechanical laws of physics can be shown to be special temporalizations of the eternal laws of possibility[46] is, for Leibniz, another evidence that the realm of nature or of mechanical necessity can be fully understood only through its relation to the realm of grace or of purpose. This, again, is the field of the middle knowledge, to show, so far as human knowledge can, that natural laws are the best possible or most determined instances of universal logical laws. In spite of the limits of our understanding, physics serves to support two important metaphysical principles: first, that the force of every real individual is private to itself, since it follows from its own law, and, second, that the realm of existence receives its purpose and value from the realm of essence, so that the mechanical order is subordinate to a spiritual realm which has its being in the relation between the two.

Physics is thus a special application of the most general principles of metaphysics on the level of well-founded phenomena, naïvely perceived—and therefore indistinctly and inadequately—as things in space and time, but adequately understood by the scientist as energetic series functioning in a responsive intercourse. Always more concerned than Newton with its relation to metaphysics and theology, Leibniz foresees the advance of physics beyond the stage of its naïve analogies of bouncing billiard balls and pelting hailstones to the subtler mathematical and dynamic analogies of fields of force.

VIII. Biology

It is in Leibniz's biological views, stimulated by the stirring discoveries of his age in that field, that he finds a compelling confirmation of his organic theory of the individual. Even within the realm of nature, mechanism is not a simple linear concatenation of impulsion and motion; it is merely an abstraction from the complex interwoven temporal progression of representation or expression. Every causal connection among phenomena rests upon this relationship and therefore upon a part-whole structure of the simplest order. For representation is itself the expression of many in one; a single perception is for Leibniz a whole composed of many contributing relations and is itself a member of a more inclusive whole, the individual monad whose law it expresses. Mechanical causality is but a phenomenal abstraction from such concrete representational unities, for, when two beings are in a representative relationship, the one whose expression is the more clear and distinct is regarded as the cause, and the one whose perception is less distinct as the effect (No. 34, Sec. 15). The determination of parts by wholes, that is, the determination of the activities ingredient in a functional system by the individual monads and transmonadic harmonies, is thus more ultimate than mechanism for Leibniz's metaphysics of existence.

Not only the individual actualized monad is a whole which determines its particular perceptions in this sense; the unity of mind and body, a plurality of monads functioning organically under the dominance of a central soul or spirit monad, is also a genuine purposive whole, even though it is not a metaphysical individual. Leibniz's vitalism is thus one of organization and function rather than of substance, and the continuity of the organism and its processes rests on functional laws and the series of events which they determine, rather than upon material unity.

Leibniz developed this vitalistic biology in direct criticism of Descartes's mechanism and in support of the remarkable discoveries which the microscope was making possible. Hobbes and the atomists, who interested him early, seemed to support Descartes, but Leeuwenhoek's discovery of cells and spermatozoa seemed to him to answer so many questions of a mechanical nature that he not only remained a vitalist but stressed the continuity of plant and animal life (letter to Bourguet; No. 69, II) and the permanence of the animal organism, subject only to processes of evolution and of "envelopment" or the loss of structures and functions. He agreed that animal behavior has its mechanical parallels and may therefore be considered as a most complex machine. But its essential nature can be understood only through a very complex soul monad, with perceptions clear enough to be considered as causes of bodily movements, and with higher laws expressed in the sequence of its perceptions than had inorganic monads—the laws enabling habituation, memory within limits, the pseudo-reasoning or "empirical consecutions" resulting from association or conditioned responses without reflection or ratiocination.

Plant and animal souls are thus monads on a higher level of organization than physical force but with energy built into the bodily structures with which they are inseparably united. The unity of the soul is in part a reflection or representation of the body, for it consists, on one level, of sensory and affective content of great complexity "caused" by the body. On the active level, however, the soul consists of the greater continuity of purpose which its power of habituation and memory, however fragmentary, makes possible. The internal causal unity of the complex purposes within an animal organism is therefore to be conceived as itself a monad, and even, within limits, a conscious monad, in functional interdependence with the naked monads which together comprise its body.

At this point Leibniz's mathematical functionalism is well adapted to support biological functionalism as well, for the stimulus-response arc and the analysis of life as the adjustment of internal to external relations in order to conserve a constancy of energy fit, almost without any translation, into his own thought. The functional unity of body and dominant soul reflects changes in its environment, first of all in the primary matter of the body monads and the resulting readjustment of their expressions, and thus in the feelings and sensibilities of the soul monad, while reactions may be instituted on various levels of bodily organization and the corresponding levels of the soul. The relation of animal soul to body is thus isomorphic, but in such a way that the purposes implicit in body mechanisms become conscious and explicit in the soul. Thus the living organism is a more perfect analogue than the inorganic body or a separate soul to the universe as a whole, where the purposes of nature become explicit in the society of spirits.

In his theory of the origin and development of the organism Leibniz was, like the most influential microbiologists of his day, a preformationist. His own theory that each monad is created by God was supported by the victory of the animalculists, following Leeuwenhoek, over the ovulists, following Harvey; the growth of the complex organism from a single cell supported his conception that all change is by internal force and not by the interplay of forces between individual and environment. But his preformationism must not be understood in a naïve and materialistic sense. Not every organ already exists in miniature in the original cell; rather the function of every organ is already determined in the laws of the changes of the original living unity. Bodies grow by aggregation, but the processes of growth are determined by the laws involved in the general harmony. In short, Leibniz is Weismannian rather than Spencerian. Though he seems not to have seen the possibility of mechanisms of heredity, his interpretation of bodily growth and depletion provides for a law of development into which surrounding conditions can introduce no new factors. Preformation involves transformation. The soul may expand with a more complex body, or suffer depletion and reduction in death, but it cannot be destroyed by nature, and all its changes are involved in its law of organization, while they evolve in harmony with a changing and enlarging environment.

It is tempting to think of Leibniz as an evolutionist. His law of continuity stimulated later theories, and he suggested a "natural evolution" within the individual organism (G., II, 399, 403). His Protogaea outlined the development of the earth and the solar system. In the later decades of his life his inclination to break the great chain of being, or at least to talk as though it did not exist, became more pronounced. But though he recognized novelties in the experience of men, both within themselves and in the external order of nature, there is nothing which is not determined by the plan of God, who creates not only individual souls but the classes to which they belong. Leibniz's tendency to emphasize progress is generally restricted to man, human history, and the realm of grace. It was characteristic of the closing century to think of continuous progress toward perfection; it was not yet within the intellectual climate to think of nature in terms of the emergence of new structures. Leibniz's theory of preformation (a special case of his logical determinism) precluded his advance to a conception of the unfolding of the forms of life, as genetic determinism still conflicts with evolution. Nor had Linnaeus yet shown the way, as he did to Kant.

IX. Psychology

It is psychology rather than biology which provides Leibniz with his most concrete metaphysical analogies, as mathematics provided him with the analogies to the universal harmony. The human situation is such that we ourselves are metaphysical individuals of high order and possessed of a unique ability to observe ourselves and thus to know one monad, at least, intimately and directly without the intervention of symbols, and therefore not as mere appearance.

Psychology[47] had been a central interest of Leibniz since his student days, when he outlined a functional account of mind, of Aristotelian pattern and without an analysis of subjective content, in a long note amplifying the ethics of Thomasius.[48] At Mainz he noted Hobbes's need of a philosophy of mind and proposed to write an Elementa de mente (Nos. 4 and 10). His general method was to find application here as well as in physics; mind was to be approached both a priori and a posteriori, both from general principles and from direct observation. In the latter method Leibniz showed great skill, particularly in studying dream processes (No. 5, III), memory, states of extreme fatigue and introversion (No. 13), and the like. His empirical psychology had as its object the mind, not the body, though he sometimes made skilful use of Hobbes's theory of physiological traces and found important analogies in animal behavior and animal drives to the organization of the human mind on levels below that of reason (No. 2). His analyses of mental growth, of the motives and processes of human learning, and even of the laws of association are thoroughly functional. Even his theory of the unconscious, though demanded by the structure of his thinking, was given support by the empirical facts of human responses.

The a priori approach to mind, on the other hand, consisted in the use of definitions to adapt the general analysis of individuality to the psychological subject. Here it was terms that made trouble for Leibniz; his difficulty was that of all introspective psychology—the illumination of inner experience through words which must be used in an analogical sense. Beginning with Aristotle and the Scholastics, he turned to Augustine's theory of memory and reflection, followed Descartes in his inclusive use of cogito, and at length settled upon the simple and revealing notions of appetite and perception, which become will and apperception when lighted by the internal sense, as the most fitting to unite the empirical and rationalistic approaches to mind.

Like all other individuals, then, the soul is a substance with modes, but only in the sense that the individual laws are the substantial sources from which the force of existing series and their changes arise. The soul is, first of all, a complete idea rooted in the universal harmony, and the very complex serial and dynamic process fulfilling that idea in continuous relationship to its environment and to its own preceding and subsequent states; it is also the actual sum or integral of these states or series of acts, combined by their interdependence into one subject. There are many strata, therefore, in the human soul throughout its temporal and spatial dimensions. The deepest is that of the law of the individual series, complex enough to be abstracted into many separate laws, and the source of the innate ideas or logical principles according to which experience is ordered. Upon it are built the impulsions or conations experienced as a basic inquietude,[49] from which appetites and desires arise. On it rest also the petites perceptions, which are innumerable in every conscious perception. The intricate continuity of perceptions and appetites which makes up the existing soul has its active representative and its passive material aspects and thus consists of an inert qualitative content expressive of the simultaneous, preceding, and consequent states of the universe. On the human level this may rise to the level of thought and will. Finally, there is the highest level, reflection or the internal sense, which penetrates into the soul itself to varying degrees, illuminating its contents, its actions, and even in part its innate law, but also always leaving an infinity of perceptions and laws dark and beyond its scrutiny. Upon this reflective power memory and reasoning depend.

Leibniz's theory of sensation and feeling provides the basis for his interpretation of the interdependence of body and mind. There is an active representation of a bodily condition by the mind, on the one hand, and a "causal" relation between an indistinct and confused mental quality (or "matter") and its more distinct bodily cause, on the other. Leibniz rejects at once any physical interpretation of sense experience (No. 71, fifth letter to Clarke, Sec. 84). A sensation is a passive quality of the soul representative of a complex bodily process; in the Paris notes and elsewhere Leibniz suggests that it expresses action and resistance in the body. No sensation is simple, for it already involves a complex of unfelt impressions, as well as memory and attention. The case of feeling is similar, though feelings are the material and qualitative aspects of the temporal transitions of the soul—the momentary impulsions from one perception to the next. Upon a permanent undercurrent of inquietude there arise the basic feelings of pleasure and pain, which are themselves, like sensations, imperfect expressions of basic harmonies—though in this case the harmonies and disharmonies of the varied impulsions are in the body and the soul itself.

But it is the unique capacity of the mind to turn upon its own acts and observe them that distinguishes it from individuals of lower order. Reflection is not self-awareness in the sense of the awareness of an ego, actor, or personal unity at every moment of experience; it is always associated with a kind of momentary memory and attention, in which the immediately past state is carried over into the present. As reflection is supported by analysis and synthesis, however, it extends beyond the awareness of immediate but confused states of mind to an awareness of the mind's processes, and eventually to its structure or law. The *ce moi* or *ego* of which he repeatedly speaks as the source of profoundest metaphysical insights is indeed implicit in the acts and processes of the mind but is distinctly perceived only in an advanced level of reflection. Self-consciousness is thus not a part of every mental act; the datum of mind is its passive content or primary matter. But reflection is the condition of all consciousness more enduring than momentary felt impulses and sensory qualities. Only through reflection can perception become apperception,[50] and appetite will, so that a clearly and distinctly perceived unity of purpose may emerge.

From 1670 on Leibniz thinks of reflection as the source of the felt unity of consciousness (Nos. 8, I; 10; 13; etc.). But such growing experience of self, still intermittent and confused, is not yet self-knowledge. To know one's self is to perceive clearly the real unity from which the manifoldly changing states emerge, and this is possible only when critical thought has discovered the permanent law of the individual series. Personal identity resides not merely in self-consciousness but in the law according to which the series of one's experience develops.

Leibniz did not, of course, anticipate the efforts of modern differential psychologists to approximate such a law of individuality, whether as psychic profile or as typical structure. His conception of method, however, would have led him to recognize the value, however limited and abstract, of both. In the law of every individual there is expressed a distinctive point of view or perspective, not only of space and time in sense perception, but of Anlage or temperament in the deepest affective and appetitive levels of the soul. For mind is made up of many strands or minor motor-affective-perceptive series corresponding to the various functions of the body, out of the interactions of which the dominant purposes of the individual arise in conformity to his individual law.

Though beasts lack this reflection, they are capable of habituation on the basis of similar responses to similar or connected sense impressions and appetites. Such pseudo-reasoning or "empirical consecution" occurs according to the laws of association, and all animals learn by this means, men certainly not least of all.[51] But such associations are not to be confused with reasoning, or the analysis and synthesis of symbolic truth, which applies to experience entirely different principles from those of association. Thus reflection or apperception, accompanying all consciousness beyond the most confused qualities of feeling, makes human intelligence possible and determines the threshold between consciousness and the unconscious.

Personality is for Leibniz essentially a moral concept. It implies apperception, for our person is "the memory and knowledge of what we are." But Leibniz is moved by the legal conception of person to find its essence in moral responsibility, thus providing the psychological unit upon which his social philosophy is built.[52]

Of the remaining metaphysical problems related to Leibniz's psychology, the most controversial are the mind-body relation and human freedom. A school of interpreters, of whom Kuno Fischer is the most prominent, has held that the spirit monad is a mind-body unity in the Aristotelian sense, mind being but the form of the body—though Leibniz called it substantial form—and body merely the matter of the mind. It must be admitted that Leibniz's own utterances are both ambiguous and contradictory on this problem; his complete view is not often stated clearly. Both materia prima and body are used in ambiguous senses, which confuse the reader. But the most coherent interpretation, clearly expressed in the correspondence with De Volder and elsewhere, ascribes a matter to the soul itself, but a soul to living and conscious bodies only, though the ingredient monads in a body are analogous to souls (No. 54, letter of June 20, 1703). The body is that organized part of creation which spirit represents or expresses most continuously and adequately, and therefore "dominates"; the body, conversely, "causes" the material content of the soul and corresponds to its activities. If cause be understood in the descriptive sense of Hume and his successors, or in the functional sense in which Leibniz defined it to Arnauld, he recognizes a causal relationship between mind and body. But efficient causality is internal to the series of events by which each monad proceeds from its law, that is, from God. In repudiating interactionism, Leibniz, like the Cartesians, was still refuting the crude theory of a physical influx which Suárez had popularized throughout Europe. He himself frequently used the language of interaction and even, in medical discussions, of psychological materialism. Ultimately he was a parallelist, not in the obvious sense of Spinoza, whose view he criticized even before he had read the Ethics (No. 12), but rather in the sense of contemporary isomorphism.

As we have already implied, Leibniz's theory of the unconscious was necessitated by his opinion that mind represents the entire universe and therefore contains levels of psychic content and organization into which the light of attention and reflection does not penetrate. The theory is not new with him, as it had arisen whenever a similar distinction was made between mens and animus or between perception and reflection.[53] The notions of repression, sublimation, hysteria-mechanisms, and the censor have been found in Leibniz, and the technique of reconstructing reactions through association as well.[54] But the unconscious serves Leibniz primarily as a bridge between his psychology and his epistemology and between a finite individual who perceives imperfectly and an infinite God and his universe. The deepest level of spirit is God himself, who "belongs to me more closely than my body" (No. 40), and who provides the norms and principles which are my guide and my duty.

The problem of freedom is not a psychological one for Leibniz. Yet he frequently approaches it from an empirical analysis, especially in his reply to Locke. Like him, he rejects a liberty of indifference and finds the clue to the analysis of choice in the relative strength of man's conflicting appetites and the feeling of inquietude which expresses this. Scientific and theological considerations unite to incline Leibniz, like most of the orthodox thinkers of his age, to a basic determinism of law, though a determinism of great complexity, and one which in his case is restricted to the efficient causality within the individual himself. Leibniz could never show the difference between God merely inclining me to certain actions and God necessitating me; all he could show was the difference between a necessity arising out of logical laws, which were not enough to determine a concrete existing world, and the necessity arising out of God's choice of the best, or the principle of least action, which does suffice to determine it. The element of probability which enters into our knowledge of our own actions is exactly the kind which enters into our knowledge of physical processes, save that the necessity which it fails to measure is within rather than without us. Leibniz identifies freedom with spontaneity, but this is merely the determined order in which the soul's active modifications proceed from its law.

In contrast to the metaphysical constructions which create these difficulties in Leibniz's psychology, however, his perceptive insights into the depths of the mind and its complex activities have proved to be suggestive to the psychologists who followed him, and the development of mentalistic psychology from Herbart's and Wundt's theories of apperception to later theories of the unconscious may be interpreted as an increasingly anti-intellectualistic and voluntaristic version of some of his views. Even today, his notions of an individual law, of an only infrequently and imperfectly organizing and guiding agent, and of the sharp difference between conditioned response and thought are guiding principles which theories of mind must take seriously.

X. Theory of Knowledge

Knowledge is a special case, but a unique one (since the monad is itself the knower), of the general process in which a metaphysical individual is related to the order of universal harmony and to the existing world which that order creates. Metaphysics is therefore prior to epistemology in Leibniz's thought; knowledge is of a real world order greater than ourselves, in which both the objects known and the principles involved in our knowing them are grounded. From his early years Leibniz supplemented Descartes's primary proposition as follows: I think, therefore I am; but I also have a diversity of thoughts, and, since a sufficient reason is needed for these being as they are, there is an existing world (No. 11). Knowledge is neither simple apprehension of being nor merely the mental creation of an order of experience. It is the revelation of independent reality under the limitations of finite representation. Man's individuality, his dependence on a point of view, and the passive elements of sense and feeling in his nature prevent pan-objectivism; the universal harmony revealed with our experience prevents a solipsism, even in the false pluralistic sense that each of us creates his private world (No. 35, I). The universal orders of possibility, nature, and grace are worlds known in common, though the point of view of each mind is different. Knowledge therefore, whether merely theoretical or involving the will, is always, insofar as it is true, a perception of the universal harmony or of its operation in existence; but, insofar as it is mediated by sensory and symbolic content, it is relative and phenomenal. Except in reflection, however, we do not perceive the subjective content of our minds; we perceive an independent reality.

Human knowledge is thus a special case of the process of perception by which the harmony between existing individuals is maintained.[55] Each perception, following the mathematical analogy, is the expression of a plurality of relations in a simple unity of content, and each perception is related purposively to the preceding and succeeding events within the mind by the law of the individual. Perceptions are not ideas. An idea is the possibility, the pattern, of a perception; it is an ingredient in the individual law which, when actualized, becomes a perception. Thus every perception has an internal meaning related to the purposes of the individual and an external meaning representative of the universe.

It is with this dual reference of human knowledge that Leibniz's logic begins, as we have already seen. When reflection opens the mind's processes and content to itself, and thus makes thought possible, the internal structure of perceptual patterns becomes reasoning (ratiocinari), the external becomes symbolic reference. And to these two aspects of knowledge the universal calculus and the universal characteristic correspond as instruments for the logical perfection of truth.

With Descartes's criterion of clear and distinct knowledge Leibniz was never satisfied, and he insisted that later Cartesians had done little to improve it. His own analysis of the stages of truth and their corresponding criteria was worked out under the stimulus of the celebrated controversy between Arnauld and Malebranche over the nature of ideas and of representation, in a paper which, to judge the frequency with which he later cited it, he considered adequate and decisive for his thought. This is the Meditations on Knowledge, Truth, and Ideas (No. 33), which he published in 1684, the first of his strictly philosophical writings. Knowledge is obscure if it fails to give recognition of the thing represented or to distinguish it from adjoining things. It is clear when it suffices for such identification. Clear knowledge, furthermore, is confused when one cannot enumerate the essential marks or determinants of the thing represented or, in short, define it; it is distinct if these marks can be enumerated. Such enumeration is a nominal definition. Distinct knowledge, again, is inadequate if a real definition can be given in terms of the determinants essential to it, so that the possibility of the concept is established; but these separate determinant notions cannot themselves be thus defined. When this can be done, however, so that the concept of the thing known has been analyzed completely into primary notions and truths, knowledge is adequate. Such knowledge, in turn, is either symbolic (or blind) or intuitive. Man has perfect intuitive knowledge only of primary notions and propositions. God, by contrast, has intuitive knowledge of the entire field of possibility and existence, past, present, and future.

The lowest and least perfect level of knowledge, which man has even in sleep and shares with animals, consists therefore of obscure and unclear feelings and sensations, without meaning though representative of reality. Pleasure and pain, however, and recognizable sense qualities are clear but confused; we can recognize them and identify them by appropriate symbols, but we cannot give their marks, since they are unanalyzable. Yet they represent forces and resistances in the body and in nature which we can conceive distinctly through analysis on mechanical principles. Animals probably share such clear but confused perceptions with men, for only such perceptions make association possible. But distinct knowledge, being based on analysis, is characteristic of man only, who is capable of distinct but inadequate knowledge in the empirical sciences, but of adequate symbolic knowledge only in the sciences of abstract possibility such as mathematics and logic. Because the serial events which constitute existence are continuous and infinite, the analysis necessary to reduce them to the simple concepts which they involve would, as we have already seen, require an infinity of steps, and is therefore impossible for man. Hence we cannot ever have adequate knowledge about truths of fact.

Leibniz's epistemology thus supports his logic by adding the psychological dimension. Human knowledge has various levels of certainty and completeness, beginning with the felt certainty of experienced qualities, and ending with the analytic certainty of purely formal reasoning. But in all meaningful facts of experience between these extremes man is committed to uncertainty, though analysis and definition may strengthen this into high probability. Reason therefore functions on two planes in human knowledge, within experience to validate it, in truths of fact, and in the realm of the purely possible, apart from concrete particulars, in truths of reason.

Upon this distinction, and the principles of method involved in it, rests Leibniz's conception of a hierarchy of empirical sciences, each of which may proceed analytically within its limit notions and with its appropriate symbols, but all of which are rooted, through common laws, in a universal logical order. Truths of reason depend on the laws of logic—identity, contradiction, and sufficient reason—in the sense that animality and rationality are sufficient for humanity. Truths of fact are established through the equivalence of definition and definiendum and the law of sufficient reason in its application to temporal events—in the sense that the bite of anopheles and certain other conditions are sufficient for malaria. Science has as its proper field the construction of symbolic models based on the observed qualities of sense, and serving to analyze them into the relations they imply. Such structures can be tested by their value in discovery and prediction, which assures us that they conform, though only imperfectly and symbolically, with the universal harmony. Leibniz's vision of the future of science was dominated by such algorithms, or mathematical models of natural structures; he himself set them up only in calculus, pure geometry, and a few less prominent mathematical and physical fields, but the wonders of recent quasi-mathematical constructions in chemistry, neurology, and genetics would have abundantly justified the faith which impelled his curiosity in biological and chemical problems. Unlike the more positivistic of modern theories, however, his own interpretation anchored these structures firmly in the universal harmony of being, on the one hand, and in the symbolizing individual, on the other.

The inadequacy of truths of fact requires a criterion of truth less certain and more highly specialized than that of mere possibility. Adequate analysis into compatible primary notions and principles, directly intuited, is a perfect criterion for truths of reason. But the intuition of sense qualities is only psychologically certain, and demonstration cannot be complete; hence we must be content with the "congruence of meanings" in the realm of time and change.

> A phenomenon will be coherent when it consists of many phenomena for which a reason can be given either in themselves or by some sufficiently simple hypothesis common to them. It is coherent, furthermore, if it conforms to the customary nature of other phenomena which have repeatedly occurred to us, so that the parts have the same position, order, and outcome in relation to the phenomenon which similar phenomena have had in the past. . . . The most valid criterion is by all means consensus with the whole se-

> quence of life, especially if others affirm that their own phenomena are in agreement with it. . . . But the most powerful criterion of the reality of phenomena, quite sufficient by itself, is success in the prediction of future phenomena from past and present ones . . . [No. 39].

The criteria of factual truth are value in prediction, coherence in the strict sense of correspondence in structure with preceding and future experiences of similar nature, and contribution to the wholeness of many separate parts of experience. In the latter connection Leibniz fully recognizes the role of hypothesis and the hypothetical nature of human knowledge of fact (Nos. 18 and 32).

The virtues of Leibniz's theory of knowledge are to be found in the clarity in which he defines the role of rational principles in establishing the validity of experience, as opposed to Locke's psychological analysis of the genesis of experience. If Descartes may be regarded as stressing the "distinctification" of knowledge, Locke its "aggregation" (Grote), Leibniz may be said to have developed the Cartesian analysis into a sharply defined methodological scale in which knowledge moves from vague quality to sharply delineated structure, but without losing either the qualitative or the purposive and dynamic function which is essential to ideas. For as the individual's knowledge grows in distinctness, his valuations, too, must rise from mere egoistic feelings to the just and socialized understanding of perfection which determines his duty. Leibniz's realistic theory of knowledge is completed by his practical conception of man and his idealistic metaphysics.

Two difficulties in this theory of knowledge remain to be pointed out. One is the problem of error. In Leibniz's moral system the good man was much clearer on the foundations of truth than on the nature of falsehood. Leibniz himself often discusses the problem in relation to his system (Nos. 13; 35, Sec. 14; 41, I; Theodicy, Prel. Dis., Sec. 44; etc.). Error is the manipulation of symbols or words, for which there is no corresponding idea. It consists of combining words, like "the greatest of all numbers" and "the greatest of all circles," whose referents are incompatible. Error is non-sense, fancy unsupported by reality, the synthesis of simple terms into an impossible notion. But how is even such negative error possible? Leibniz's difficulty arises out of his determinism. How can a being whose every action and passive experience follow from the law of his individual nature, that is, from the ideas essential to his nature, set up a combination of symbols and acts to which no idea corresponds and which is therefore expressive of nothing? This would indeed demand a liberty of indifference. Equally difficult is the view in the Discourse that ideas are from God, but the relations between them—the source of error—from us. His own conception of error (and evil) should have forced Leibniz either to set up inconsistent and incoherent ideas as real, which would have destroyed the perfection of God, or to introduce a real indeterminism into man. Though he suggests the latter in his exoteric writings, this is always in violence to the law of the individual.

The second problem concerns the role of self-experience in providing metaphysical truth. Leibniz frequently says that it is only in reflection that we discover the true meaning of such categories as being, identity, causality, and unity. Does such metaphysical knowledge rest upon analogy or is it direct apprehension of the deepest level of man's own nature, where he is bound to God by the law of his individuality? Is Leibniz's meaning to be understood as pointing to an external thing-in-itself analogous to the analyzed structure of our own mind or to an internal transcendental principle of unity or being? Is he confirming the Scholastics or anticipating the post-Kantian idealists? Both views can be argued from his own words, and commentators have felt obligated to choose one interpretation or the other. But he himself regarded them as reinforcing each other, for is not God the underlying harmony expressed in my own inmost activities but in the external order as well, so that he may be reached, not only by the less certain via externa, but by the less public but more direct via interna as well?

XI. Summary: Structure and Purpose

With the union of the internal analogy from consciousness and the external analogy from the mathematical-logical structure of existence, Leibniz's metaphysics assumes its final form, in terms of which his principles are unified and the various realms of existence and essence harmonized.

In the first place, his principles are established and ordered in a scale of universality corresponding to the three orders of being, the possible or essential, the creative, and the existent. On the level of logical necessity these principles are two in number; Leibniz regards both as self-evident, though the former rests in his religious faith. They are the principles of perfection and of identity. The principles of plenitude and of harmony are involved in perfection; the principle of contradiction is involved in identity. The law of sufficient reason itself rests on the perfection of the universe and the possibility of the analysis which is implied in identity. Since perfection implies existence, and therefore plurality with mutual limitation, there must be a creative process, corresponding to the middle knowledge. In this process the "anagogical principle" of maximal determination or the best possible necessarily follows from the notion of a perfect world order in which the law of identity continues to be valid throughout the limiting choices; every complete substance must still be equivalent to the sum of its predicates. This law of the best possible has its special analogues—the principle of maxima and minima in mathematics, of least action or the extremum in physics, and the law of parsimony in methodology. On the level of existence, finally, the principles of continuity and individual differentiation (the identity of indiscernibles) follow from the law of perfection. And under temporal and spatial conditions which we have already described, sufficient reason becomes mechanical causality, and identity becomes equipollence in its various forms—equality in algebra, congruence and similarity in geometry, equivalence in symbolic logic, and the conservation of force, along with its special derivative forms, in dynamics.

Of this structure of principles only the foundation is unproved, for Leibniz succeeded in deriving the others by the deductive process of limiting definitions. But his efforts to establish the existence of perfection itself, in the form of the ontological argument, never succeeded, so that existence was never completely welded to his a priori system of principles.

The continuous scale of monads of which existence consists is now also as completely defined as possible for human minds. All monads alike are temporal series of active force and passive content, representative of the universe and striving toward the purposes defined in the individualized law from which they proceed. In his later writings Leibniz preferred to simplify this structure into the two functions of appetite and perception. In the simplest or bare monads, these are without any memory or reflection, so that the harmony of the world is completely external to them and mechanical. Soul monads[56] contain an internality of purpose because perception is accompanied by attention and habituation and is therefore sentient. But spirit monads are possessed of reflection and memory of a kind which enables them to think and unify the purposes implicit in their appetites and perceptions, so that they are capable of "expressing God rather than nature"; the purposes of God are internal to them, so that they become moral persons, citizens of the kingdom of grace. The principle of perfection requires, however, that no two monads be identical but that the greatest variety of value and perfection should exist. So there is a continuous scale of monads, from the simplest to the most complex intelligences, extending far beyond the limitations of man himself. As the immediate source of all monads, exercising a purposive limitation of total possibilities, God himself, may be called a primitive monad in contrast to created ones.[57]

Finally, Leibniz's combination of mechanism and purpose is now also complete. Purpose is immanent with every monad, because its law involves its perfection, not as existent but as essential. Since the individual laws all involve each other, the universal harmony is but the most perfect possible integration of individual perfectibilities. Mechanism, on the other hand, is but the phenomenal and abstract universalized description of the relations of representation between the states of individual monads. Contingency within nature therefore provides the basis for the anagogical problem which occupied so great a place in Leibniz's later thinking (Nos. 50 and 51) as the basis for a spiritual interpretation of natural phenomena. In Leibniz's thought it took the form of an argument to a supreme cause on the basis of the maximal fitness of existing laws of contingency. The religious application of this theory is found in the union of the two realms of nature and of grace in every individual substance. Every monad contributes to both realms, since every monad is part of a machine and of a system of purposes. But only self-experiencing monads have intrinsic values to be achieved in harmony with others, and therefore only spirit monads dwell consciously in the two realms. Grace is the presence of the perfect in the law of our nature, in such a way that we consciously strive toward it. The kingdom of grace is therefore the realm in which essence modifies existence by providing its purpose. It is in this sense that every spirit monad expresses God rather than the world.

The kingdom of grace is the arena in which man seeks the good individually and in community with his fellows. Even our confused feelings reflect not merely temporal but eternal harmonies; the value which Leibniz found in luminous instinct and the "blind" emotional impulses of the soul was largely overlooked by his followers in the Enlightenment but was revived, along with the work in which it is most explicit, by men who sought to found the greatest harmonies upon feeling.[58] Feelings and instincts are themselves confused expressions of harmonies whose structure can be revealed more adequately by reason. It is on this foundation that Leibniz developed his conception of the levels of ethics and the law.

XII. Ethics and Social Thought

The widespread impression that Leibniz's ethics and value theory are an insignificant and uncritical aspect of his thought rests in part on the fact that his writings in these fields have been neglected and in part on an ad hominem argument from the man's position and temperament. One misses in Leibniz, the courtier, the disregard which Spinoza showed for external circumstances and established opinions as well as Spinoza's sympathetic tolerance with human motives. Yet the burden of his thought was ethical, and value experiences, together with theoretical knowledge, are for him the distinctively human ways of expressing the universal harmony. Unlike his scientific ideas, his practical philosophy was not altered as his thought developed. Though the selections on ethics and the philosophy of law in these volumes represent several periods in his work (Nos. 6, 43, and 58), they do not differ in any essentials, for the very good reason that the metaphysical and psychological foundations—universal perfection and man's relatively imperfect perception of it—were laid early.

Leibniz's theory of value has been variously described as hedonistic and perfectionistic. It was both, of course, since pleasure and pain are the confused perception of universal harmony or disharmony, and the confused subjective impressions of action as well. This harmony or disharmony may be within the physical organism, it may be in the spirit's perceptions and appetites of itself, it may be in the wider realm of creation—grief at the state of others is of this kind, as is love—but in the realm of pure essence there can be only harmony. Thus only the beatific vision of God is unalloyed joy. Even the greatest harmonies may be felt confusedly, as is true in music and art. Yet it is this feeling which determines the value. It is in this sense that Leibniz is a hedonist, though his hedonism is "well founded" in objective structures, whether existential or possible. He is not only a hedonist but an egoist as well; the argument between Bossuet and Fénélon on the existence of nonmercenary love had already been answered by him in the negative, and he frequently referred to his opinion on this controversy (No. 44, I and II). Feelings are merely the passive aspects of impulsions or appetites, and every human impulse involves self-interest; it arises within the monad by its own law and is directed toward the future good of the monad itself. Leibniz thus relates values to the fundamental human drives as well as to the feelings, and it is in his analysis of these motives that his exploration of the good begins. All broader and higher motives must be compatible with this basic egoism.

Several higher interests serve to socialize our egoistic impulses and are therefore particularly important for law. One is the desire for praise. This is an unclear feeling or mirroring of the opinions of others, which moves men, even below the level of true honnêteté, to consider others. It reflects an imperfect kind of social harmony but involves no distinct perception of it (No. 6, II). A much more distinct expression of this harmony, and therefore far more important in Leibniz's social thought, is love. "To love is to find pleasure in the happiness of the beloved and his perfection." Love is thus three-dimensioned—it is always egoistic, since its motive is self-pleasure, but it is always directed toward the happiness of others (which, in turn, consists of their feeling for their own growth in perfection) and therefore is also directed toward perfection or God. Hence charity and piety are but aspects of the same fundamental social virtue.

Upon this analysis of human motives Leibniz builds his conception of the three levels of justice in law. Strict law rests, as Hobbes saw, upon egoistic impulses and demands external power to prevent men from harming each other when their self-interests conflict. Its maxim is neminem laedere. On the level of equity, however, or of charity in a narrow sense, no coercion from without is needed, for there is greater clarity as to the social conditions of happiness. Its maxim is suum cuique tribuere. The highest level, piety, is the basis of justice in honorable men themselves, for whom both wisdom and charity flow from considerations of the universal harmony.

It presupposes the existence of God and a community of immortal minds over which he rules. Its maxim is the golden rule, which is summed up in honeste vivere (Nos. 44 and 59).[59]

This is not an unqualified Platonism. For Leibniz my duty involves a plurality both of people and of values. The harmonies which evoke my uneasiness and my impulsions are the incomplete and imperfect ones implied in my law of individuality. Egoism is the fundamental limit imposed upon me by my finiteness, in which I am not wholly like any of my fellows. All value involves personal effort and personal satisfaction, even the supreme good, the beatific vision. Leibniz repudiates the false mysticism of "Averroists" like Valentine Weigel and Angelus Silesius, who describe this highest value as personal cessation or a kind of death. To be is to strive. Every value is relative to the point of view of an individual, yet values may increase in distinctness and adequacy as the objective harmony they involve is conceived more adequately. Without this harmony there would be no striving, and hence no feeling of pleasure and pain.

This pluralism is also implicit in Leibniz's analysis of social forms. His social thought is fundamentally medieval in important respects, since he seeks a universal society of good men, a universal church, and a legal basis for universal justice. Following Aristotle and Felden (No. 44, IV), he recognizes various types of societies built about natural needs and values and upon varied principles of human relationship. But all societies are to be measured by human happiness, and there is no indication that Leibniz favors an "unlimited" society on the political level—"a society which concerns the whole life and the common good." Such totalitarianism he recognizes as desirable only within the family and among understanding friends. His theory of history too, insofar as he had one, supports this individualism; history is concerned with the social movement toward perfection (No. 69), but the universal harmony toward which it strives is to be expressed in the perfection, and therefore the happiness, of the individuals of whose relations history consists.

Three particular fields of human value play a conspicuous role in Leibniz's thought.

1. *Moral values*. The moral end Leibniz usually sums up in the "public good," that is, in the happiness or enduring pleasure of spirits in as wide a social extent as possible. In this he is a genuine humanist, even to identifying the love of others with the love of God himself.

> The place of the other (*autrui*) is the true perspective point in politics as well as morals, and the precept of Jesus Christ, to put oneself in the place of the other, serves not only the end of which our master spoke, namely morality, but that of politics as well [Bod. LH., XXXIV, 8, fol. 28].

Duty is the compulsion of the individual by acknowledged harmonies, social and ideal; hence it implies both pleasure and wisdom. *Honestas* is thus the basic personal virtue, love the basic social, and piety the ultimate metaphysical virtue. The unity of these Leibniz frequently affirmed. To Thomas Burnet he wrote, in an indirect appeal to Newton to publish his theory of colors:

> You know my principles, Sir, which are to prefer the public good to all other considerations, even to glory and gold. I have no doubt that a person of the force of Mr. Newton shares my belief. The sounder one is, the more one has this disposition, which is the great principle of the man of honor, and even of justice and true piety, for to contribute to the public good and to the glory of God is the same thing [1669; G., III, 261].

2. *Aesthetic value*. Leibniz, as we have seen, found a clue to creation in the work of the architect who plans the most elegant structure which his medium and site allow (No. 51). Beauty is delight in felt or understood harmony and in the strivings which these feelings accompany. Though his remarks on aesthetics are casual and incomplete, Leibniz stimulated both classicists (Baumgarten) and romanticists, the former stressing the harmonies in beauty, the latter the unclear perceptions.[60] His own tastes were of course classical, though he seems also to have collected folklore and peasant verse and other expressions of simple feelings and intuitions

(Bod. LH., chaps. v and xxxix). His analysis of music reveals both interests. In music a mathematical order of physical vibrations, perceived indistinctly, "is transmitted by our hearing and creates a sympathetic echo in us, to which our animal spirits respond. This is why music is so well adapted to move our minds, even though this main purpose is not usually noticed nor sufficiently sought for" (No. 44, III). Beauty is thus not merely feeling but impulsion to higher harmonies, not necessarily themselves restricted to the experience of beauty.

3. The vision of God. Mysticism is a significant motive in Leibniz's thought (Nos. 23 and 40). Yet upon examination his attitude toward it seems one of intellectual interest and appreciation rather than deep personal experience, for there is about him a kind of surface flatness to which depth and intensity of feeling are foreign. Leibniz was a lifelong student not only of various forms of religious excitement, on which he made notes and comments and for some of which he found naturalistic explanations, but also of the varied forms of the religious consciousness. In his later years he was suspected of disregarding the public practices of religion; Hanover burghers called him "Löve-nix" (Glaube nichts).

Yet the experience of God is ingredient in his metaphysics, for the monads are closed to external influence save from God, of whom every moment of their being is a fulguration. There are passages in his writings expressive of an exalted piety, not merely in their content, but in the very handwriting and the periods of his rhetoric. The true vision of God is for him a morally compelling experience whose validity is to be tested by its social fruits. But the nature of the vision is intuitive; it may be on the level of unclear and confused perception, or, on a higher plane, it may rise to an adequate grasp of the perfection upon which well-being, our own and others', depends.

But what of disvalue? Leibniz is not insensitive to the evils of the world, but he cannot consistently recognize any evil except that of unclear and confused perception, that is, of narrowly egoistic impulsions based on very imperfect harmonies. His frequent quotation of Ovid's well-known confession is an acceptance of human imperfection.

> Video meliora proboque, deteriora sequor.[61]

But though he is not inclined to underestimate the strength of moral evil (No. 23, II), his philosophy gives it only an ambiguous place. One is never clear whether the realm of grace really exists already or whether it is still to be built. Evil is feeling and being impelled by an imperfection less than the best possible and is therefore to be overcome within the self-consciousness of man. But whence imperfection and disharmony, why less than the best possible or, indeed, than the perfect—these questions Leibniz, bound to the chain of logical order, cannot answer.

XIII. Theology

One of Leibniz's early projects, the Catholic Demonstrations, was a proposal to apply his general science and his metaphysics to a rational apology for orthodox Christianity so distinct and adequate that it should compel assent. It came to nothing, and the Theodicy, his published defense of God written many decades later, proved to be neither so rigorous nor so universally convincing, though it became the basis of his wider European influence. Both works show the centrality of theology in Leibniz's thought. His thought was to be a rational theology, and, though he used the distinction between natural and revealed religion, he regarded both as on the same level of adequate perception; God, the "region of ideas," the great calculator, must be shown to be the greatest of princes who reigns with perfect justice and love in the commonwealth of grace. But, in pressing the adequacy of reason, he left for faith only the role of personal assent and conviction, the established body of truth being beyond all possibility of doubt. Faith needed only to follow where reason led. Thus the paradox of his theological goal; wanting to establish Christian faith, he actually helped support the extreme rational optimism of the age which followed.

Leibniz spent much care upon theological issues which were not central to his moral concern; conspicuous among these was the problem of Christ's presence in the Eucharist. But central to his thought was the problem of God, his providence, and man's relation to him. Christianity could be established as the religion of reason by showing that it provides concepts which supply that inclusive structure of meaning which modern science and moral order require for their unity. The hope of European order seemed to rest upon this issue, and Leibniz's strongest fears were directed at tendencies which seemed to deny either the existence of God or the substantial nature and order of creation. Atheism and libertinism, on the one hand, and "Averroism" and Quietism, on the other—these were the two modern "sects of naturalism" (G., VII, 333-34) which his system was to overcome. Thus the problems of his theology are, in the first place, the nature of God and his providence, the freedom of man, and, as its culmination, the realm of grace, that ideal social order in which man exercises his freedom as subject and son of God.

Leibniz's first task was to prove the existence of God. According to the plan of 1668-69, the first part of his Catholic Demonstrations was entirely concerned with this problem. His arguments were at once both a priori and a posteriori, though he was compelled to cling to the former with unusual persistence because the entire structure of his system rests on the reality of perfection. Unless the perfect being can be established by the method of analysis, the entire conception of an analytic logic and a metaphysics of harmony is unfounded.

1. The first formulation of the argument for God, however, was a posteriori. This was the argument in the Confession of Nature against Atheists and the Catholic Demonstrations (No. 5, I), a special case of the cosmological proof resting on Descartes's theory of matter. Assuming that bodies are real, there is no ex-

planation within themselves of motion, figure, and cohesion. Since these depend upon active principles, their origin must, according to the principle of sufficient reason, be mental, and the harmony of the corporeal system demands that this mind be one.

The cosmological argument remained Leibniz's most enduring one, though it was altered as his conception of the physical world changed. In its mature form it depends upon the distinction between existence and possibility and upon the application of the principle of sufficient reason to the existing order as a whole (No. 51). Granting that the existing world is a contingent system of causes, in both the immanent sense within each monad and the external functional sense between monads, it is still a particular world, and we must grant that there might have been worlds organized on a different system of laws. Causal explanations within nature never escape contingency and therefore still leave unanswered the question, "Why this world rather than another?" or, in the special case of man, "Dic! Cur hic?" To answer this question is to be driven beyond "thisness" to the will of God as an explanation, since this question necessarily involves a principle of selection.

Leibniz's contemporaries were not inclined to deny the validity of this question and its answer. Newton had set up virtually the same argument, though based upon a different view of physical things, in the famous Scholium at the close of his Principia. It remained for a later, more positivistic era, to challenge the entire principle of reason on which it rested, and to deny the metaphysical relevance of the fact that the universe is as it is and might have been otherwise.

2. With the introduction of a principle of selection, however, the cosmological argument becomes teleological. The anagogical principle to which Leibniz appeals (No. 50) is an effort to reason to the reality of perfect harmony from the limited perfection and interdependence of finite things. The argument has a cosmological and a humanistic part. The principle of the extremum, which Leib-

niz demonstrated in the case of the laws of dioptrics, is, as we have seen, of continuing importance and use in physics. Yet as a mathematical principle it implies at most that the natural order is a unique determination of possibility, as every integral equation is a uniquely determined case of a family of infinite members, with an arbitrary parameter, based on the same differential equation.[62] Only Leibniz's Platonism permitted that identification of goodness with logical determinateness which transformed his discovery into an argument for God.

Applied to man and his purposes, however, the same reasoning becomes a value argument. Leibniz thought of it as one from the beginning. Chapter v of the Catholic Demonstrations, Part I, was to contain "a demonstration of infinite probability, or of moral certainty, that the beauty of the world arises from mind." In brief, man's value experience, aesthetic, moral, social, and religious, involves harmonies greater than himself, though the power of achieving them is in part his own. Against Malebranche he maintained that a finite spirit could perceive infinity, however imperfectly. This, he felt, was a particularly compelling argument in the realm of truth, the binder of the values. But the human quest for greater perfection in law, morality, art, science, and religion implies an order of perfection from which come both norms and fulfilment.

Insofar as this argument regards God as sufficient reason for the absolute in our value experience, it is as valid as the cosmological, and no more so, since both involve the extension of the principle of sufficient reason from the descriptive and contingent to the possible and absolute. Yet the value argument possesses an empirical plausibility which the more general form of the teleological argument lacks. This is but one instance of many in which the psychological analogy, from the nature of man's consciousness to metaphysical principles, has a force which the mathematical analogy in Leibniz lacks, since the psychological evidence already, following Descartes's famous maxim, implies existence, and the leap from possibility to existence, the pitfall of all rationalism, is thus unnecessary. But the argument, of course, has its own empirical difficulty, the problem of evil. Sin is, as Russell points out, merely materia prima and the limited actions arising out of this source of confusion (No. 29). Within this inadequate a priori conception of evil, Leibniz offers the various explanations of badness that have been used in every theodicy which has appeared since—the appeal to ignorance, to the instrumental goods involved in many apparent evils, to the possibility of higher spirits than man, to the necessity for restricting the good of the individual in the best society, to immortality and its assurance of continued growth toward perfection. Evil, being merely the religious term for the finiteness implied in existence, time, and plurality, thus becomes virtually a datum in the teleological argument.

3. Intimately involved in the preceding arguments for God's existence is that from the nature of eternal truths. Leibniz is, as we have seen, a conceptualist; truth involves intellect and therefore mind. Many contemporary thinkers will accept Leibniz's opinion that human thought implies the objective subsistence of logical relations but will deny their mental nature. Bertrand Russell, in particular, to whom the reader may be referred for a critical account of Leibniz's arguments, calls this one "scandalous" because it confuses God's knowledge with the truths which he knows and implies ultimately that God's existence rests upon his own understanding.[63] But Russell's criticism is not itself without a trace of scandal, for nowhere else is he so substantialistic in his own thought, and nowhere else does he thus misinterpret Leibniz's theory of mind and ideas. Leibniz's view of mind, whether God's or man's, is not substantive in the Cartesian sense. Mind is ideas operating; it is itself a law which abides through a series of "values" or events. God is not a knower who transcends his ideas and works according to them; here Leibniz's criticism of Descartes's voluntarism is decisive. But God, being perfect, must have self-awareness, and in this sense it may actually be said that God's existence

does depend on his knowledge of the ideas. The significant question is not whether the eternal truths involve God in this sense but whether they involve a doctrine of creation and providence and the God which these imply.

4. But all these arguments are a posteriori and do not achieve the certainty which Leibniz demanded for this foundation of his system. They become conclusive only with the ontological argument, since they all involve the existence of harmonious ideas or perfection. Even before his stay in Paris, Leibniz was influenced by his study of Descartes, and a little later, of Spinoza, to wrestle with this proof (Nos. 7, I; 13; 14; and 16). Descartes proved that, if the idea of a most perfect being is possible, it exists. But he did not prove that "the most perfect being" is a possible idea; his definition may be purely verbal, as are those of such inconsistent pseudo-notions as the greatest number and the largest circle. How establish the possibility of a most perfect being? The closest Leibniz comes to an answer is his demonstration, to Spinoza in 1676, that perfect attributes must be compatible, a demonstration which he achieves only by defining perfections from the start as simple notions. But this begs the entire argument, since logical simplicity is relative; and the divine perfections cannot so easily be identified with the primary concepts and principles of my thought.[64] A more successful proof is never reached, and, though Leibniz later repeats his criticism of Descartes and restates the argument, it is always equivalent to the assertion that perfection exists and that the rest of his principles follow from it.

With Leibniz's failure at this point, his logic and his metaphysics fall apart, and the latter remains, as he frequently admits, a hypothetical structure. Thus his last philosophical summaries, the Principles of Nature and of Grace and the Monadology, reason from the nature of individuals and their interdependence to the universal harmony, and thus by the psychological analogy to God. The ultimate pattern of Leibniz's argument must therefore be considered as a posteriori.

But when atheists are refuted, the problem of grace yet remains, and this involves the question of human freedom. Leibniz is deeply concerned with preserving the sovereignty of God without destroying a moral distinction between good men, whom he conceives as men of honor, and bad men, or moral libertines. Man's will must enter into the efficacy of grace, and it must be his will, and not God's. Yet to deny the divine source of all perfections, and the divine foreknowledge of all temporal events, is itself atheism. Moreover, Leibniz was always more concerned for orderly than for free living. "The highest perfection of man consists not merely in that he acts freely but still more in that he acts with reason; or rather, the two are the same thing" (No. 42, I, Sec. 37). Leibniz therefore sees little difficulty in his theory of the law of the individual series, which is the true individual substance, from which man's will flows—determined, indeed, but self-determined. There is no freedom of indifference or indeterminacy; all essence is logically determined, all existence, through the created individual laws. The element of probability which enters into human actions is of the same kind as that which enters into mechanical processes elsewhere in nature; ultimately both could be reduced, by an omniscient being, to the necessity by which different series of events follow from their individual laws and represent each other.

Yet Leibniz is impressed, on the other hand, by the urgency of human choice and believes that the notion of the individual law does preserve for man a real freedom. The entire force of a monad's being, both its acts and the passive content of its experience, arise from its own nature; its dependence on the rest of creation is secondary and phenomenal, the realm of scientific description and generalization. Appetite and perception, becoming will and intellect in man and grasping the nature of God himself, are man's own. Practically, he must act as if his past is determined but his future not. The power is within himself in the law of his nature, though his attainments are as broad as the universe itself. It is in this sense, Leibniz holds, that God may be said to incline rather than to necessitate, though inclination is never blocked save by a stronger inclination.

This is quibbling, and we must choose between the empirical Leibniz, interested in human experiences of truth and value, and the theological Leibniz interested in an a priori glorification of God. Yet it is quibbling that has been peculiarly convincing in the philosophical tradition, for the alternative is for many thinkers the abandonment of metaphysical order.

The crown of Leibniz's theological thinking is found, however, in his accounts of the commonwealth of spirits, whose monarch is God, related to his subjects not merely as a king but as a father to his children. Here Leibniz's beliefs reach their emotional and moral climax. The kingdom of grace is the unfailing conclusion to every finished exposition of his thought; it is the bond of reference between his system and the ills of Europe. It gives an overreaching purpose to the realm of nature,[65] for man is the complex individual in whom the two realms are consciously united. It implies moral freedom on the part of its subjects, through deliberate and voluntary obedience to the order of law. It is at once the highest goal of man's efforts and the highest achievement of God's creation. Leibniz believes that it can be both, since man's moral growth follows God's creative plan, and man is so constituted by nature as to be fulfilled in the law of the kingdom, which is love.

Both the value of human life and the glory of God's kingdom are infinitely enhanced by immortality. Leibniz has two arguments for it: granting the existence of perfection, it solves the problem of evil; and the nature of individual substance demands it. Every monad exists by virtue of its own law and its own power; since this cannot be interfered with from without, it cannot be destroyed—save by the intervention of God. That this means a repetition or continuation, in the case of man, of reflection, conscious memory, and purpose is Leibniz's faith, rooted in the moral requirements of a divine justice. Monads may continue in a greatly restricted state;

this happens in the case of death. But soul and spirit monads always involve a materia prima and therefore a body, however reduced in complexity, of which this is the reflection. The laws of this body may involve the grounds of renewed awareness and memory. Immortality, not merely of the spirit but of the organism, is therefore the highest perfection of the unified kingdoms of nature and of grace.

XIV. Leibniz's Consistency and Influence

The outstanding insecurities and strains in Leibniz's philosophical structure have been pointed out in the course of our exposition. But, like other parts of the human adventure, philosophy advances by its inconsistencies; reculer pour mieux sauter—to step back in order the better to leap forward—was for Leibniz himself the rule of historical progress. We may stop briefly to consider some of the permanent values in the imposing and intricate pattern of his ideas.

It was characteristic of his mode of philosophizing, and of his conception of error as well, that he rarely found falsehood in his own ideas and not much oftener in those of his adversaries. Usually he saw only incompleteness which was to be remedied by further, more adequate analysis. And, in spite of shifts of emphasis from logic to physics and from universal to individual, it must be admitted that in the main his thought is a progressive unfolding of the notions involved in his particular perspective on the world, the law of his own intellectual nature, from the beginning.

Yet the ambiguities, the gaps, and the contradictions are there, as we have seen. No philosopher was more eager to subject his views to criticism (though he rarely changed them as a result); yet debate never fully cleared up the ambiguities in his conception of simple ideas, primary matter, the nature of corporeal beings, the relation between mind and body, man's freedom. The most conspicuous gap is the missing cornerstone—his failure to prove the existence of perfection.

The result of this is that, as an a priori structure, his rationalism falls short of rigorous demonstration. And this is just where he left it himself, though he never explicitly gave up the hope of establishing his principles adequately through the ontological argument.

But perhaps this failure in some ways merely makes clearer the value of the rationalistic mode of thought for our own time. For the result is a shift of emphasis from the eternal as a starting point for philosophy to the use of reason in discovering and interpreting the temporal order of existence itself. The close relation between reason and perception is the clue to the power of Leibniz's method. It is true that his arguments rest on postulates that are unproved, except insofar as they are tested by their coherence and their empirical adequacy. All the more then do they demonstrate the structure of human understanding. Leibniz's successful application of rational principles to contingent and natural events is one of the great achievements of modern philosophy, and his rationalism remains valid as an exploration of the principles involved in the possibility of science and morality itself, as an exposition of the method by which experience is organized, verified, and corrected through analysis and synthesis. In this sense the rationalism of Leibniz remains a permanent supplement and corrective to Locke's empiricism.

The other failures in Leibniz's thought are closely related to this underlying one. Thus his theory that logic and reality are completely commensurate must be surrendered, not merely because his own conception of the proposition was too restricted to serve as a logical net within which to capture existence, change, plurality, and freedom, but because reality is prior to and deeper than logic. It imposes itself on logic rather than the reverse. And this, again, leads to a shift from the effort to supply rigid logical limits to being, to the logical challenge inherent in the complexities and infinitely varying qualities of existence. There is no part of being to which the selective stripping and labeling of logic cannot be made to apply, and its skeleton may ever thus be laid bare. But the logic that does so must follow rather than lead and copy rather than create. In his logical calculus and universal characteristic, Leibniz began to explore the traits of a logic which can do this.

Though Leibniz achieved a genuine pluralism in existence through his conception of individual laws, it is not of a kind that supports the individualism even of the honorable man, the man of good will. For here too he never loosens the reins with which an intellectualistic God holds all existence in his grasp. Time and finitude are only necessary consequences of the greatest possible perfection. Here, again, the strong pluralistic and temporalistic interests of Leibniz which gradually come to the fore against this deterministic background may be emphasized. He was too good a historian and scientist not to give full attention to the principles of differentiation and change or to neglect the tools which his mathematics offered for measuring it. Much of his thinking is done from the individual outward, and he was a pioneer in exploring the secret parts and unplumbed depths of man's soul.

Again, Leibniz had no explanation, except the enduring Augustinian one, of the source of limitation, opposition, and resistance within the universal harmony. There is logical profundity, but great obscurity as well, in the sorites involved in creation—perfection implies plurality, plurality implies simultaneity and succession, time and space are the forms of activity and passivity and therefore involve opposition. But ultimately he can only point to the empirical fact; bodies do collide, impulses are opposed to each other, psychological and social forces do clash. Harmony is only partly a fact, and in part an ideal, a norm, in human experience. The realm of the possible and potential may indeed be a real realm, but the two worlds of essence and existence, and the two levels of truth built upon them, cannot be bridged from the top down but only imperfectly from the experience of the existent outward.

Leibniz's own symbolic logic, finally, and his ideal of science require a conception of freedom which he does not accept. It lies within the power of the thinker to choose his own characters and signs; the man in error combines signs for which there are no corresponding ideas. And what is true of error is by that very fact true of evil as well. Man's free choice implies that possibility is broader than existence, as Leibniz insisted. But it follows directly that possibility cannot itself contain the principles which determine existence.

Thus there appears a basic alternative, a shift in viewpoint, which the student who wishes to learn from Leibniz must face. His age and his own genius confirmed the logician and mathematician in him, while his devotion to fact pushed him to acknowledge the unclear, the indistinct, and the relative, to a point far beyond the superficial clarities and rationalizations of the age which followed him. One must choose between the Leibniz who recognizes the symbolic and analogical nature of human thought but seeks the universal logical and moral norms which make it possible and the Leibniz who would analyze possibility and find existence hidden within it. The choice is between his two great analogies—mathematical relationships or psychological continuity within a phenomenally presented environment. It is the choice of beginning either from the pure logic of analysis and failing to build a metaphysics or from the awareness of the human situation but with a willingness to proceed beyond phenomena to the principles on which they may be "well founded." To one student at least, it is the latter Leibniz, who begins with human problems and human symbols but retains the powerful tools of reason not only in mathematics and logic but in life, without sacrificing the adventure of human creativeness, who seems to offer the more fruitful philosophical answers.

The fertility of Leibniz's ideas is revealed in later thought. His influence, though not the acuteness of his analyses, now seems to have outlived and outreached Kant's. A school of followers established the principles of his mathematics and opened the way to the triumphs of modern theoretical mechanics. Even before his death another group of younger men professed discipleship in philosophy.

Himself opposed to the sectarian attitude, he aroused strong partisanship in both fields. Unfortunately it was his speculative writings that immediately survived him, many of his scientific and logical works remaining buried in the library at Hanover. Along with Bayle's Dictionary and Locke's Essay, the Theodicy was a standard item in the libraries of eighteenth-century philosophical dilettantes. The mood of the Theodicy survived Voltaire's ridicule and, sacrificing depth as it achieved popularity, lived until the pessimism movement of the nineteenth century; even Darwin could not help reflecting it.

The deeper influence of Leibniz's thought reached in other directions, however. Hume accepted his emphasis upon analysis in the spirit of a skeptic, tearing apart matters of fact from ideas of relations, and also moral purpose from logical possibility. Under the influence of Christian Wolff, on the other hand, a rationalized and materialized Leibnizianism reached the academic halls which he himself had repudiated—systematized into a school philosophy by the sacrifice of many of its profundities such as the relativity of time and space, the organic and purely logico-dynamic nature of the monads, and all elements of inadequacy in perception. Wolff thus attempted the reconciliation of Leibniz and Newton on the latter's terms—a blunder which history has corrected. But Wolff also preserved the Leibnizian interest in possibility and aided Kant in finding his essential answers to the question of the possibility of judgments of existence. Accepting the synthetic nature of such judgments as ultimate, not merely for us but in principle, Kant explains them through the creative role of the ultimate principles of meaning, now categories with the power of constituting experience, not merely analyzing and understanding it. For Kant, as for Leibniz, space and time are the conditions in terms of which the categories of possible experience are schematized into the principles of empirical science. For him, as for Leibniz, will is practical reason, and freedom is determination by the rational nature. His Critique of Judgment is, as Cassirer has pointed out, an exploration of the implications of harmony in nature; and God, freedom, and immortality remain for him fundamental ideas in the realm of possibility and of practical value. Kant's paralogisms and antinomies are Leibniz's attempted demonstrations (in the case of God) and infinite analyses (in the case of cosmology), seen through the analytic eyes of Hume. Thus Hegel, though aware of a theory of concreteness different from Leibniz's, is able to return from Kant to his great predecessor's theory that existence is the maximum determination of the possible, and his principle that predicates are included in their subjects—provided that the subjects are concrete in Kant's organic sense.

Leibniz's theory that feelings and instincts too reflect universal harmonies exerted an influence beyond the Enlightenment and his own distrust of enthusiasm. The appearance of the New Essays in 1765 gave encouragement to the Romantic reaction against mere intellect and to a deepened classicism as well, with the result that Goethe's deep poetic faith in man's intuition, and his cosmic dynamism and monadism, but also Hegel's rational synthesis of the various cultural values of romanticism and mysticism, appear as variants of the earlier thinker's views. In a more naturalistic period Herbart and Wundt (not to mention James) adopt his dynamic psychology, while Schopenhauer revives his theory of unconscious perceptions with biological emphasis. Toward the end of the century vitalism reappears in biology, and the revolution in physics offers both empirical and theoretical evidence for Leibniz's dynamism and relativism.

Today most of these issues and convictions are still alive. Differences in viewpoint are still sharp. Schools are still flourishing. But there is again a strong impatience with philosophical sectarianism, and the spirit of Leibniz's quest for a philosophia perennis is more significant, perhaps, than his particular theories. In the combined attack upon common intellectual problems, there are aspects of his thought which once more may serve as rallying points for new and more advanced work. A few may be noted.

1. Leibniz's conviction that there are great human values in scientific discovery (if moral and social safeguards are maintained) and that the power of science lies in organized, co-operative research has seen triumphs in our days which are enormous beyond anything he imagined. But the problem, not merely of a philosophy of science, but of a philosophy, theoretical and practical, methodological and metaphysical, adequate to organize the scientific enterprise within an acceptable social and cultural order, still remains.

2. His vision of a general science of characters and operations is still alive, as are his own projects in the field—the construction of a universal calculus, a universal language, and a universal encyclopedia. His thought may well suggest that such a science may be compatible, not with a linguistic positivism alone, but with a metaphysics of universals and persons.

The belief that analogy will serve as a method to reveal isomorphisms underlying a hierarchy of sciences is a related ideal that still defines directions for scientific advance. And the algorithms and models whose value he predicted in the various fields of human creativity are now finding application, as he foresaw, in education as well as in prediction and creation, and in the arts as well as the sciences and technology.

3. In metaphysics Leibniz's most fruitful contribution has been his ordered dynamism, for it stimulated the great modern revolutions in physics, biology, and psychology as well as in philosophy. Time once more succeeded space as the frame for existence, and substance was redefined in terms of structure and function, so that process remained amenable to mathematical analysis. Directly implied in this shift, too, was the new concept of organism, involving a plurality of processes reflecting a basic harmony of dependent parts. His analysis of possibilities in existence is in the spirit of neorealism, yet his epistemology is a mode of critical realism. It is not to be wondered at that the metaphysical syntheses which best respond to the scientific and moral interests of our own times, whose problems parallel in such complex forms those of the

seventeenth century, should return to this pattern. Thus Peirce, who knew Leibniz better than any other American of his time, returns to his logic and reinterprets his basic categories—existence, possibility, and harmony—as chance, logic, and love, breaking the great chain of being and releasing the free forces of existence. Whitehead too has given expression to the basic Platonism and dynamism which moved Leibniz, with results offering striking analogies as well as instructive differences from the earlier thinker's conclusions. An empiricism more concerned with the objective implications of reason, an existentialism with greater faith in logic (if this is not a contradiction in terms), a personalism more intent upon scientific analysis—these and others we may still learn from Leibniz. In spite of deep differences, a pattern of thought may thus be affirmed which stresses the organic unity and common relations of all being, on the one hand, yet tries to do justice to freedom and purpose, fact and value. This would be the form of modern Leibnizianism.

Finally, Leibniz's fundamental humanism, his concern for moral and cultural ends to be attained in a social environment of language, law, technology, and religion, supports the needed moral solutions for the problems of our warlike century. An organization of United Nations (at least in the European sphere) and an age of justice to be made effective through the common purposes of men of good will were not beyond the vision of Leibniz's age. But its choices were wrong, and the increase of evils which resulted defines the crisis of our own years. Good will still requires, not merely warm feelings, but both individual self-determination to the good and the perception of possible harmonies that are universal. And to correct our inadequate perceptions and build these harmonies *in actu* demands the perfection of common language, common law, and a common faith.

BIBLIOGRAPHY

This list does not claim to be comprehensive, but aims to give the essential materials and tools for a more thorough study of Leibniz's philosophy and to indicate something of the range of interpretation which the various phases of his thought have received. The adequate though not exhaustive bibliography in Ueberweg, *Grundriss der Geschichte der Philosophie*, III (12th ed., 1924), 304-7, 673-81, may be supplemented by the lists in the works by Mahnke and Ropohl cited below.

I

The following bibliographical works are indispensable for Leibniz scholarship:

Bod. B. Bodemann, Eduard. *Der Briefwechsel des Gottfried Wilhelm Leibniz in der Königlichen Öffentlichen Bibliothek zu Hannover*. Hanover, 1889.

Bod. LH. Bodemann, Eduard. *Die Leibniz-Handschriften der Königlichen Öffentlichen Bibliothek zu Hannover*. Hanover, 1895.

Rav. Ravier, Émile. *Bibliographie des oeuvres de Leibniz*. Paris, 1937.

The first two works provide a key to the Hanover manuscripts only but contain much material not elsewhere available. Ravier's book lists only publications of Leibniz's own writings, from 1663 to 1935 (882 items). Professor Paul Schrecker's corrections and additions in *Revue philosophique de la France et de l'étranger*, LXIII (1938), 324 ff., should be consulted with this work, which is valuable for its many historical notes.

II

The most useful editions of Leibniz's own works, including all those used for the translations given here, are the following:

PA. Leibniz, G. W. *Sämtliche Schriften und Briefe*. Edited by the Preussische Akademie der Wissenschaften. Darmstadt and Leipzig, 1923-54.

Only the following volumes have appeared in this monumental effort to publish a complete and critical edition.

Reihe I: Politischer und historischer Briefwechsel, Vols. I-V.
Reihe II: Philosophischer Briefwechsel, Vol. I (1663-84).
Reihe III: Politische Schriften, Vol. I (1667-76).
Reihe VI: Philosophische Schriften, Vol. I (1663-72).

Until this edition is completed, the student must rely on the following sources, none of which is adequate by itself.

Dut. *God. Guil. Leibnitii . . . Opera omnia*. Edited by Louis Dutens. Geneva, 1768--.

An outstanding example of eighteenth-century editing and still the most comprehensive edition of Leibniz's work as a whole.

G. Leibniz, G. W. *Philosophische Schriften*. Edited by C. I. Gerhardt. 7 vols. Berlin, 1875-90.

GM. Leibniz, G. W. *Mathematische Schriften*. Edited by C. I. Gerhardt. 7 vols. Berlin and Halle, 1849-55.

These two editions are still the most extensive collections of the philosophical and mathematical works, with texts based primarily on the Hanover manuscripts.

Erd. *God. Guil. Leibnitii Opera philosophiae quae extant*. Edited by Joh. Ed. Erdmann. [illegible] vols. Berlin, 1840.

Erdmann's collection was also based on the Hanover materials.

F. de C. Foucher de Careil. *Nouvelles lettres et opuscules inédits de Leibniz*. Paris, 1857.

Foucher de Careil had already published a less important collection of *Lettres et opuscules inédits* in 1854. In 1859 he began the publication of the collected *Oeuvres*, of which seven volumes of historical, political, and theological writings appeared. The texts are inferior to those of G., Erd., and Klopp.

Klopp *Die Werke von Leibniz*, Erste Reihe: *Historisch-politische und staatswissenschaftliche Schriften*. Edited by O. Klopp. 11 vols. Hanover, 1864-84.

Still the most inclusive source for Leibniz's political and historical works.

Guh. DS.	*Leibniz' Deutsche Schriften*. Edited by G. E. Guhrauer. 2 vols. Berlin, 1838-40. Contains materials primarily of biographical interest.
Mollat	Mollat, G. *Mitteilungen aus Leibnizens ungedruckten Schriften*. Leipzig, 1893. A useful selection from the writings on ethics and the philosophy of law.
Cout. OF.	Couturat, Louis. *Opuscules et fragments inédits de Leibniz*. Paris, 1903. The most complete edition of Leibniz's papers on logic and related fields, supplementary to Cout. L., which led to a new understanding of his importance in logic and methodology.
Ger.	*Leibnizens Nachgelassene Schriften physikalischen, mechanischen, und tecknischen Inhalts*. Edited by E. Gerland. Leipzig, 1906. Reveals the range of Leibniz's technological interests.
Grua	Grua, G. *G. W. Leibniz: Textes inédits d'après les manuscrits de la Bibliothèque provinciale de Hanovre*. 2 vols. Paris, 1948. A gleaning of unpublished materials in ethics, theology, religion, and political philosophy, with excellent notes.
Jag.	Jagodinski, I. *Leibnitiana elementa philosophiae arcanae de summa rerum*. Kasan, 1913. An edition, with Russian translation, of notes from the Paris period.
Sch.	Leibniz, G. W. *Ausgewählte philosophische Schriften im Originaltext*. Edited by H. Schmalenbach. 2 vols. Leipzig, 1915--. A comparative text of an important selection of the philosophical works, collating the best published versions.
	Schrecker, Paul. *G. W. Leibniz: Lettres et fragments inédits*. Paris, 1934. An excellent edition of papers and letters found in the National Library at Warsaw.
BC.	Leibniz, G. W. *Hauptschriften zur Gründung der Philosophie*. Edited by E. Cassirer; translated by A. Buchenau. 2d ed. [illegible] vols. Leipzig, 1924. Along with German translations of the *Theodicy* and

the *New Essays*, this makes up the most useful German version of Leibniz. Cassirer's notes are a valuable extension of his earlier interpretation (Cas.).

Other editions, including those of individual works, may be found listed in Ueberweg and Ravier.

III

The most important previously available English translations of Leibniz's philosophical works are the following:

Duncan, G. M. (trans.). *The Philosophical Works of Leibnitz*. 2d ed. New Haven, 1908.

Langley, A. G. (trans.). *New Essays concerning Human Understanding, by Gottfried Wilhelm Leibniz; Together with an Appendix of Some of His Shorter Pieces*. 2d ed. Chicago, 1916.

Latta, R. (ed.). *Leibniz: The Monadology and Other Philosophical Writings*. Oxford, 1898.

Morris, Mary. *The Philosophical Writings of Leibniz, Selected and Translated*. New York: "Everyman's Library," 1934.

Montgomery, G. R. W. *Leibniz: Discourse on Metaphysics, Correspondence with Arnauld, and Monadology*. Chicago, 1902.

Wiener, Philip P. (ed.). *Leibniz Selections*. ("Modern Students Library.") New York, 1951.

All these collections contain materials not included in the present volumes. Among other translations may be mentioned H. W. Carr's edition of the *Monadology*, with introduction, commentary, and supplementary essays (London, 1930); J. M. Child's *Leibniz's Early Mathematical Manuscripts* (Chicago, 1921), with a critical discussion of the origin of the calculus; and the early translations in the *Journal of Speculative Philosophy*, 1867-71, by F. H. Hedge (No. 67), Thomas Davidson (No. 63), and A. E. Kroeger (Nos. 47 and 58).

IV

The best available biographical materials are still to be found in the following works:

Guh. L. Guhrauer, G. E. *Gottfried Wilhelm Freiherr von Leibniz: Eine Biographie*. 2 vols. Breslau, 1842.
Though corrected and supplemented at many points, this is still the most complete biography. A condensation, in English, but without Guhrauer's rich collection of materials, appeared three years later: J. N. Mackie's *Life of G. W. von Leibnitz* (Boston, 1845).

Fischer, Kuno. *G. W. Leibniz: Leben, Werke, und Lehre*. 5th ed. Heidelberg, 1920.
The appendix to this edition, by W. Kabitz, corrects both Fischer and Guhrauer on many details and reports on the biographical research until 1920. An account of Leibniz's life by the discoverer of many new details, Professor Paul Ritter, is found in *Ueberweg*, III (12th ed.), 307-14.

Huber, Kurt. *Leibniz*. Munich, 1951.
This small book, written in part in prison and left incomplete when the Munich professor was sentenced to death by Hitler's Volksgericht in 1943, contains new information about the influences upon Leibniz and a contribution to critical apparatus as well.

On the seventeenth-century background, Voltaire's classic *Siècle de Louis XIV* may be supplemented by the following valuable studies:

Clarke, G. N. *The Seventeenth Century*. Oxford, 1929.

Dilthey, W. "Leibniz und sein Zeitalter," *Gesammelte Schriften*, Vol. III. Leipzig, 1927.

Hazard, Paul. *La Crise de la conscience européenne, 1680-1715*. 3 vols. Paris, 1935.

Meyer, R. W. *Leibniz und die Europäische Ordnungskrise*. Hamburg, 1948. English translation by J. P. Stern, *Leibnitz and the Seventeenth-Century Revolution*. Cambridge, 1952.

V

Out of the vast literature of interpretation which has been built upon Leibniz's thought, only those works which contribute to contemporary reappraisal and understanding have been selected. Of nineteenth-century interpretations, the most influential was that of J. E. Erdmann, *Versuch einer wissenschaftlichen Darstellung der Geschichte der neueren Philosophie*, Volume IV, which centered attention upon Leibniz's metaphysics and theory of knowledge, and their relation to his scientific work, to the neglect of logic and methodology. In various measures this work influenced the interpretations even of such men as Eduard Zeller, *Geschichte der deutschen Philosophie seit Leibniz* (1873), and Kuno Fischer, in the work mentioned in Section III. Fischer's analysis of the monad differs distinctly from that of Erdmann, however. J. T. Merz's *Leibniz* (Edinburgh, 1884), still the best introduction in English, also reflects Erdmann's point of view and limitations.

Three great works, however, all appearing within a few years at the beginning of the twentieth century, may be considered the beginnings of more recent criticism. All of them are profound but one-sided, and all three stress Leibniz's logic as the key to his thought.

Cas. Cassirer, Ernst. *Leibniz's System in seinen wissenschaftlichen Grundlagen*. Marburg, 1902.

Cassirer's interpretation is Neo-Kantian and identifies Leibniz's logic with the formal principles of possible experience. In a supplement he criticizes the two following works. Cassirer makes it clear in a later note, however (BC., II, 95-96), that he considered this thorough study as merely preliminary, and not a complete account.

Cout. L. Couturat, Louis. *La Logique de Leibniz d'après documents inédits*. Paris, 1901.

This careful and critical study is restricted to logic and the projects related to it. Couturat later described Leibniz's approach to metaphysics from logic in "Sur la métaphysique de Leibniz," *Revue de métaphysique et de morale*, X (1902), 1-25. Couturat's conception of logic was mathematical, and his interpretation is distinctly different from Cassirer's.

Russell, Bertrand. *A Critical Exposition of the Philosophy of Leibniz*. Cambridge, 1900.

Russell reduces Leibniz's thought to basic premises and criticizes it as a deductive system. His admirable

analysis involves a relative neglect, however, of the complex structure of the thought. Russell reviewed the positions of Cassirer and Couturat in "Recent Work in the Philosophy of Leibniz," *Mind*, XII (1903), 177-201.

Corrective in one way or another of these one-sided interpretations are the following important works:

Boutroux, Émile. *La Philosophie allemande au XVII^e siècle*. Paris, 1929.
These lectures from 1887 to 1888, together with Boutroux's introductions to his editions of the *Monadology* and the *New Essays*, Book I, combine a concern for scientific methodology with an idealistic metaphysics.

Joseph, H. W. B. *Lectures on the Philosophy of Leibniz*. Oxford, 1949.
Lectures for undergraduates; a clear and sharp analysis of some breaking points in the system.

K. Kabitz, W. *Die Philosophie des jungen Leibniz*. Heidelberg, 1909.
Primarily a historical study, this work affirms the essentially metaphysical nature of Leibniz's thought.

Lovejoy, A. O. *The Great Chain of Being*, esp. chap. v. Cambridge, Mass., 1936.
This study of the Platonic tradition in Western thought puts Leibniz into the proper historical stream and shows the ambiguity between his temporalism and eternalism.

Mahnke, D. *Leibnizens Synthese von Individualmetaphysik und Universalmathematik*. Halle, 1925.
Extremely valuable for its criticism of the important Leibniz interpretations since 1900. Mahnke himself seeks the unity of Leibniz's individualism and universalism in phenomenology.

Pichler, H. *Leibniz: Ein harmonisches Gespräch*. Graz, 1919.
A sensitively conceived Leibnizian dialogue showing the unity of the logic, ethics, and aesthetics.

Schmalenbach, H. *Leibniz*. Munich, 1921.
Seeks to interpret Leibniz's thought as the confluence of the streams of Protestant individualism and modern scientific universalism, combining a culture-historical with a metaphysical study.

Wundt, W. *Leibniz: Zu seinem zweihundertjahrigen Geburtstag*. Leipzig, 1917.
A short but brilliant interpretation based on the physical theories.

Among the more general introductions into Leibniz's thought, the student may find the following helpful, though they contain some distortions and inaccuracies:

Carr, H. W. *Leibniz*. London, 1929.

Hönigswald, R. *G. W. Leibniz*. Tübingen, 1929.

Stammler, G. *Leibniz*. (Fromann's Klassiker.) Munich, 1930.

VI

Of the special studies on separate fields of Leibniz's thought, the following selections are most useful.

1. For discussions of special *metaphysical* problems:

Biema, Émile van. *L'Espace et le temps chez Leibniz et chez Kant*. Paris, 1908.

Blondel, M. *Une Énigme historique: Le "Vinculum substantiale" d'après Leibniz et l'ébauche d'un réalisme supérieur*. Paris, 1930.

Boehm, A. *Le "Vinculum substantiale" chez Leibniz: Ses origines historiques*. Paris, 1938.
Both studies emphasize the Scholastic origins of the concept.

Hicks, G. Dawes. "The 'Modes of Spinoza' and the 'Monads' of Leibniz," in *Critical Realism*. London, 1938.
Hicks investigates the problem of Leibniz's success in establishing individualism within the bounds of an absolute.

Kanthack-Heufelder, K. *Die psychische Kausalität und ihre Bedeutung für das Leibnizische System*. I. Teil. Leipzig, 1939.

Ropohl, H. *Das Eine und die Welt*. Leipzig, 1936.
An examination of the problem of the one and the many. A list of Leibniz bibliographies is included.

2. On *logic*, *epistemology*, and *methodology*.

Dürr, K. *Neue Beleuchtung einer Theorie von Leibniz*. Darmstadt, 1930.

Matzat, H. *Untersuchungen über die metaphysischen Grundlagen der Leibnizschen Zeichenkunst*. Berlin, 1938.

These works examine the foundations of the universal characteristic and logical calculus, particularly their relations to metaphysics.

Heimsoeth, H. *Die Methode der Erkenntnis bei Descartes und Leibniz*. Giessen, 1914.

A detailed and critical analysis of methodology in Leibniz, distinguishing it sharply from epistemology.

Pape, Ingetrud. *Leibniz, Zugang und Deutung aus dem Wahrheitsproblem*. Stuttgart, 1949.

Wiener, Philip P., "Notes on Leibniz's Conception of Logic and Its Historical Context," *Philosophical Review*, XLVIII (1939), 567-86.

3. *Mathematics* and *physics*. Cantor's *Vorlesungen über Geschichte der Mathematik* remains the most careful study of Leibniz's contributions to the former field, and E. Mach's *The Science of Mechanics* is still useful, though far from adequate, in the latter.

Hofmann, J. E. *Die Entwicklungsgeschichte der Leibnizschen Mathematik während des Aufenthaltes in Paris, 1672-1676*. Munich, 1949.

See also the work by Hofmann listed in the Introduction, note 11.

Scholz, H., "Leibniz und die mathematische Grundlagungsforschung," *Jahresber. der deutschen Mathematikervereinigung*, LII (1942), 217-44.

A clear account of Leibniz's general science as metaphysics, stressing the role of the principles of possibility, existence, and the extremum or best possible.

Gueroult, M. *Dynamique et métaphysique Leibniziennes*. Paris, 1934.

The most thorough study of the relation of physical to metaphysical views; traces the development of the physical concepts, with particular emphasis upon Leibniz's debt to Huygens.

4. *Psychology* and related fields. The most adequate general discussion is in Max Dessoir's *Geschichte der neueren deutschen Psychologie* (Berlin, 1902). Of the large body of monographs and studies, the following are perhaps most helpful.

Döhl, I. *Bewusstseinsschichtung: Ein Beitrag zur Entstehungsgeschichte ihrer Theorie, insbesondere durch Nachweis von Ursprungen bei Leibniz.* Berlin, 1935.
Leibniz as forerunner of psychoanalytic concepts.

Ganz, R. *Das Unbewusste bei Leibniz.* Zurich, 1917.

Grau, K. J. *Die Entwicklung des Bewusstseinsbegriffes im XVII. u. XVIII. Jahrhunderts.* Halle, 1916.

Strahm, H. *Die "petites perceptions" im System von Leibniz.* Bern, 1930.

5. *Ethics* and *theology*. Leibniz's ethics and value theory have been neglected. His position is described in L. le Chevallier's *La Morale de Leibniz* (Paris, 1933).

The work of two men, Baruzi and Kiefl, is of basic importance in understanding his religious motives and ideas. Their works are as follows:

Baruzi, J. *Leibniz et l'organisation religieuse de la terre.* Paris, 1907.

Baruzi, J. *Leibniz, avec de nombreux textes inédits.* Paris, 1909.
Both books contain much source material.

Kiefl, F. X. *Der Friedensplan des Leibniz zur Wiedervereinigung der getrennten christlichen Kirchen.* Paderborn, 1903.

Kiefl, F. X. *Leibniz; Der Europaeische Freiheitskampf gegen die Hegemonie Frankreichs.* Mainz, 1913.

A good English account of the unification efforts is G. T. Jordan's *The Reunion of the Churches: A Study of G. W. Leibnitz and His Great Attempt* (London, 1927).

For the concept of God, the following may be consulted:

Görland, A. *Der Gottesbegriff bei Leibniz.* Giessen, 1907.

Rolland, E. *Le Déterminisme monadique et le problème de Dieu dans la philosophie de Leibniz*. Paris, 1935.

The interesting and unexplored field of Leibniz's relation to Malebranche is opened in G. Stieler's *Leibniz und Malebranche und das Theodizeeproblem* (Darmstadt, 1930). Georges Friedmann's *Leibniz et Spinoza* (Paris, 1946) is a thorough study of the historical and philosophical relations between these two thinkers.

6. *Politics*, *law*, and *history*. An enumeration of Leibniz's achievements in legal theory is found in the following works:

MacDonell, John. "Gottfried Wilhelm von Leibniz," in *Great Jurists of the World*. Boston, 1914.

Cairns, Huntington. *Legal Philosophy from Plato to Hegel*, chap. ix. Baltimore, 1949.

For the sources and historical importance of Leibniz's political concepts see the following:

Basch, Victor. *Les Doctrines politiques des philosophes classiques de l'Allemagne*. Paris, 1927.

Ruck, E. *Die Leibnizische Staatsidee aus den Quellen dargestellt*. Tübingen, 1909.

On Leibniz's significance as a historian, consult:

Conze, W. "Leibniz als Historiker," in E. Hochstetter (ed.), *Leibniz zu seinem 300. Geburtstag*. Berlin: De Gruyter. (In preparation.)

Daville, Louis. *Leibniz historienne*. Paris, 1909.

Two recent studies on Leibniz's relations to Russia are of contemporary interest. In some ways they supplement the older work by W. Guerrier, *Leibniz in seinen Beziehungen zu Russland und Peter dem Grossen* (Leipzig, 1873), which contains most of the important sources.

Benz, Ernst. "Leibniz und Peter der Grosse" (1947), in Hochstetter, *op. cit*.

Richter, L. *Leibniz und sein Russlandbild*. Berlin, 1946.

7. An indication of the continued importance of Leibniz's thought may be found in the numerous publica-

tions which the tercentennial of his birth in 1946 called forth. The volume of essays prepared under the editorial leadership of E. Hochstetter, several times mentioned above, is of importance in summarizing recent research on the several aspects of Leibniz's work. Another collection of essays and three special editions of philosophical journals are also noteworthy:

Gottfried Wilhelm Leibniz: Vortrage der aus Anlass seines 300. Geburtstages. in Hamburg abgehaltenen wissenschaftlichen Tagung. Hamburg, 1946.

Journal of the History of Ideas, September, 1946.

Revue philosophique de la France et de l'étranger, October-December, 1946.

Zeitschrift für philosophische Forschung. Ergänzungsheft, 1947.

PART I

MAINZ AND PARIS, 1666-76

1

DISSERTATION ON THE ART OF COMBINATIONS

1666

(Selections)

The Dissertatio de arte combinatoria, which Leibniz published in 1666, was an expansion of the dissertation and theses submitted for disputation the same year to qualify for a position in the philosophical faculty at Leipzig. The work contains the germ of the plan for a universal characteristic and logical calculus, which was to occupy his thinking for the rest of his life. That project is here conceived as a problem in the arithmetical combination of simple into complex concepts, Leibniz deriving basic theorems on permutation and combination and applying them to the classification of cases in logic, law, theology, and other fields of thought. His later judgment on the work was that in spite of its immaturity and its defects, especially in mathematics, its basic purpose was sound.

Three introductory sections which supply the metaphysical and logical foundations of the work are given here. They are (I) a demonstration of the existence of God with which he prefaced the work; (II) the "corollaries" prepared for the disputation; and (III) the definitions introducing the work itself. The solution of the first two problems and several applications are also included.

* * *

[G., IV, 32-33]

I

DEMONSTRATION OF THE EXISTENCE OF GOD

Hypotheses [Praecognita]:[1]

1. Definition 1. God is an incorporeal substance of infinite

power [*virtus*].

2. Definition 2. I call *substance* whatever moves or is moved.

3. Definition 3. *Infinite power* is an original capacity [*potentia*] to move the infinite. For power is the same as original capacity; hence we say that secondary causes operate by virtue [*virtus*] of the primary.

4. Postulate. Any number of things whatever may be taken simultaneously and yet be treated as one whole. If anyone makes bold to deny this, I will prove it. The concept of *parts* is this: given a plurality of beings all of which are understood to have something in common; then, since it is inconvenient or impossible to enumerate all of them every time, one name is thought of which takes the place of all the parts in our reasoning, to make the expression shorter. This is called the *whole*. But in any number of given things whatever, even infinite, we can understand what is true of all, since we can enumerate them all individually, at least in an infinite time. It is therefore permissible to use one name in our reasoning in place of all, and this will itself be a *whole*.[2]

5. Axiom 1. If anything is moved, there is a mover.

6. Axiom 2. Every moving body is being moved.

7. Axiom 3. If all its parts are moved, the whole is moved.

8. Axiom 4. Every body whatsoever has an infinite number of parts; or, as is commonly said, the continuum is infinitely divisible.

9. Observation. There is a moving body.

Proof [Ἔκθεσις]:

1. Body *A* is in motion, by hypothesis No. 9.
2. Therefore there is something which moves it, by No. 5,
3. and this is either incorporeal
4. because it is of infinite power, by No. 3;
5. since *A*, which it moves, has infinite parts, by No. 8;
6. and is a substance, by No. 2.
7. It is therefore God, by No. 1. Q.E.D.
8. Or it is a body,

9. which we may call B.

10. This is also moved, by No. 6,

11. and what we have demonstrated about body A again applies, so that

12. either we must sometime arrive at an incorporeal power, as we showed in the case of A, in steps 1-7 of the proof, and therefore at God;

13. or in the infinite whole there exist bodies which move each other continuously.

14. All these taken together as one whole can be called C, by No. 4.

15. And since all the parts of C are moved, by step 13,

16. C itself is moved, by No. 6,

17. and by some other being, by No. 5,

18. namely, by an incorporeal being, since we have already included all bodies, back to infinity, in C, by step 14. But we need something other than C, by 17 and 19,

19. which must have infinite power, by step No. 3, since C, which is moved by it, is infinite, by steps 13 and 14;

20. and which is a substance, by No. 2,

21. and therefore God, by No. 1.

Therefore, God exists. Q.E.D.[3]

II

COROLLARIES FOR DISPUTATION[4]

[G., IV, 41-43]

An Arithmetical Disputation on Complexions, which Mr. Gottfried Wilhelm Leibniz of Leipzig will hold in the famous university of Leipzig, by permission of its distinguished philosophical faculty, on March 7, 1666.

I. Logic.

1. There are two primary propositions. The first is the principle of all theorems or necessary propositions: what is (so)

either is or is not (so), or conversely. The other is the basis of all observations or contingent propositions: *something exists*.

2. Perfect demonstrations are possible in all disciplines.

3. If we regard the disciplines in themselves, they are all *theoretical*; if their application, they are all *practical*. Those, however, from which the application follows more immediately are rightly called practical par excellence.

4. Although every method can be employed in every discipline, as we follow the traces either of our own investigation or of the producing nature in our treatment, it yet happens in the practical disciplines that the *order of nature* and *that of knowledge* coincides, because here the *nature of the thing* itself originates in our *thought* and production. For the end in view both moves us to produce the means and leads us to know them, which is not true in the matters which we can merely know but cannot also produce. Moreover, although every method is allowed, not every one is expedient.

5. The end of logic is not the *syllogism* but *simple contemplation*. The *proposition* is, in fact, the means to this end, and the syllogism is the means to the proposition.

II. *Metaphysics*.

1. One infinite is greater than another. (Cardan, *Pract. Arith.*, chap. 66, nn. 165 and 260. Seth Ward is said to dissent in his *Arithmetic of Infinites*.)[5]

2. God is substance; creature is accident.

3. A discipline concerning created beings in general is needed, but this is nowadays usually included in metaphysics.

4. It is very improbable that the term *cause* expresses an unequivocal concept to cover efficient, material, formal, and final causes. For what is the word *influx*, more than a mere word?[6]

III. *Physics*.

1. Since we may observe that other cosmic bodies move about their own axes, it is not absurd that the same should be true

of the earth; but neither is the contrary.

2. Since the most general difference between bodies is that of density and rarity,[7] the four primary qualities may obviously be explained as follows: the humid is the rare, the dry is the dense, the warm is the rarefying, and the cold is the condensing. Everything rare is easily confined within external boundaries, but with difficulty within its own boundaries; everything dense, the contrary. In the rare, everything that rarefies facilitates the quickening of the homogeneous with respect to itself and the separation of the heterogenous; in the dense the way to this is blocked. A reason is thus supplied for the Aristotelian definitions. Nor does fire, which seems to be rare but must actually be dry, provide an exception to this, for I reply that one thing is to be said about fire per se and another of fire which inheres in other bodies, for in this case it follows the nature of these bodies. Thus it is clear that a flame, which is nothing but burning air, must be fluid just as is air itself. On the other hand, the fire which consists of burning iron is like iron itself.

3. It is a fiction that the force of the magnet is checked by steel.

IV. Practical.

1. Justice (particular) is a virtue serving the mean in the affections of one man toward another, the affections of enjoying and of harming, or those of good will and hate. The rule of the mean is to gratify another (or myself) as long as this does not harm a third person (or another). This must be noted in order to defend Aristotle against the cavil of Grotius, who speaks as follows in the Prolegomena of his de Jure belli et pacis (Sec. 4):

> That this principle (that virtue consists in the mean) cannot correctly be assumed as universal is clear even in the case of justice. For since he (Aristotle) was unable to find the opposites of excess and defect in the affections and the actions which follow from them, he sought them both in the things themselves with which justice is concerned. But this is obviously to leap from one genus of things to another, a fault which he rightly criticizes in others.[8]

Grotius, namely, maintains that it is inconsistent to introduce into the species of a classification something which is derived by another principle of classification; he calls this, not too philosophically, "leaping over into another genus." Certainly the mean in affections is one thing, the mean in things another, and virtues are habits, not of things but of minds. Therefore I show that justice is also found in a moderation of the affections.

2. Thrasymachus well says, in Plato's Republic, Book i, that justice is what is useful to the more powerful. For in a proper and simple sense, God is more powerful than others. In an absolute sense one man is not more powerful than another, since it is possible for a strong man to be killed by a weak one. Besides, usefulness to God is not a matter of profit but of honor. Therefore the glory of God is obviously the measure of all law. Anyone who consults the theologians, moralists, and writers on cases of conscience will find that most of them base their arguments on this. Once this principle is established as certain, therefore, the doctrine of justice can be worked out scientifically. Until now this has not been done.[9]

III

Cum Deo!

[G., IV, 35-75]

1. Metaphysics, to begin at the top, deals with being and with the affections of being as well. Just as the affections of a natural body are not themselves bodies, however, so the affections of a being are not themselves beings.

2. An affection (or mode) of a being, moreover, is either something absolute, which is called quality, or something relative, and this latter is either the affection of a thing relative to its parts if it has any, that is, quantity, or that of one thing relative to another, relation. But if we speak more accurately and assume a part to be different from the whole, the quantity of a thing is also a re-

lation to its part.

3. Therefore, it is obvious that neither quality nor quantity nor relation is a being; it is their treatment in a signate actuality that belongs to metaphysics.

4. Furthermore, every relation is either one of *union* or one of *harmony* [*convenientia*]. In union the things between which there is this relation are called *parts*, and taken together with their union, a *whole*. This happens whenever we take many things simultaneously as *one*. By *one* we mean whatever we think of in one intellectual act, or at once. For example, we often grasp a number, however large, all at once in a kind of blind thought, namely, when we read figures on paper which not even the age of Methuselah would suffice to count explicitly.

5. The concept of *unity* is abstracted from the concept of one being, and the whole itself, abstracted from unities, or the totality, is called *number*.[10] *Quantity* is therefore the number of parts. Hence quantity and number obviously coincide in the thing itself, but quantity is sometimes interpreted extrinsically, as it were, in a relation or ratio to another quantity, to aid us, namely, when the number of parts is unknown.

6. This is the origin of the ingenious specious analysis[11] which *Descartes* was the first to work out, and which *Francis Schotten* and *Erasmus Bartholin* later organized into principles, the latter in what he calls the *Elements of Universal Mathematics*. *Analysis* is thus the science of ratios and proportions, or of unknown quantity, while *arithmetic* is the science of known quantity, or numbers. But the Scholastics falsely believed that number arises only from the division of the continuum and cannot be applied to incorporeal beings. For number is a kind of incorporeal figure, as it were, which arises from the union of any beings whatever; for example, God, an angel, a man, and motion taken together are four.

7. Since number is therefore something of greatest universality, it rightly belongs to metaphysics, if you take metaphysics to be the science of those properties which are common to all

classes of beings. For to speak accurately, mathematics (adopting this term now) is not one discipline but small parts taken out of different disciplines and dealing with the quantity of the objects belonging to each of them. These parts have rightly grown together because of their cognate nature. For as arithmetic and analysis deal with the quantity of beings, so geometry deals with the quantity of bodies, or of the space which is coextensive with bodies. Far be it from us, certainly, to destroy the social distribution of disciplines among the professions, which has followed convenience in teaching rather than the order of nature.

8. Furthermore, the whole itself (and thus number or totality) can be broken up into parts, smaller wholes as it were. This is the basis of complexions, provided you understand that there are common parts in the different smaller wholes themselves. For example, let the whole be ABC; then AB, BC, and AC will be smaller wholes, its parts. And the disposition of the smallest parts, or of the parts assumed to be smallest (that is, the unities) in relation to each other and to the whole can itself also be varied. Such a disposition is called situs.[12]

9. So there arise two kinds of variation: complexion and situs. And viewed in themselves, both complexion and situs belong to metaphysics, or to the science of whole and parts. If we look at their variability, however, that is, at the quantity of variation, we must turn to numbers and to arithmetic. I am inclined to think that the science of complexions pertains more to pure arithmetic, and that of situs to an arithmetic of figure. For so we understand unities to produce a line. I want to note here in passing, however, that unities can be arranged either in a straight line or in a circle or some other closed line or lines which outline a figure. In the former case they are in absolute situs or that of parts to the whole, or order; in the latter they are in relative situs or that of parts to parts, or vicinity. In definitions 4 and 5, below, we shall tell how these differ. Here these preliminary remarks will suffice to bring to light the discipline upon which our subject matter is based.[13]

Definitions

1. *Variation* here means change of relation. For change may be one of substance, or of quantity, or of quality; still another kind changes nothing in the thing but only its relation, its situs, its conjunction with some other thing.

2. *Variability* is the quantity of all variations. For the limits of powers taken in abstraction denote their quantity; so it is frequently said in mechanics that the power of one machine is double that of another.

3. *Situs* is the location of parts.

4. Situs is either absolute or relative; the former is that of the parts with respect to the whole, the latter that of parts to parts. In the former the number of places is considered, and the distance from the beginning and the end; in the latter neither the beginning nor the end is considered, but only the distance of one part from another part is viewed. Hence the former is expressed by a line or by lines which do not inclose a figure or close upon themselves, and best by a straight line; the latter is expressed by a line or lines inclosing a figure, and best by a circle. In the former much consideration is given to priority and posteriority; in the latter, none. We will therefore do well to call the former *order*,

5. And the latter *vicinity*. The former is disposition; the latter, composition. Thus by reason of order the following situses are different: *abcd*, *bcda*, *cdab*, *dabc*. But in vicinity there can be no variation but only situs, namely, this: $\underline{a}\overset{b}{\underset{d}{-}}\underline{c}$. Thus when the very witty Taubman was dean of the philosophical faculty at Wittenberg, he is said to have placed the names of Master's candidates on the public program in a circular arrangement, so that eager readers should not learn who held the position of "swine."[14]

6. We will usually mean the variability of order when we take variations par excellence; for example, 4 things can be arranged in 24 ways.[15]

7. The variability of a complex we call *complexions*; for ex-

ample, 4 things can be put together in 15 different ways.[16]

8. The number of varying things we shall call simply number; for example, 4 in the case proposed.

9. A complexion is the union of a smaller whole within the greater, as we have said in the introduction.

10. In order to determine a certain complexion, however, the greater whole is to be divided into equal parts assumed as minima (that is, parts now not to be considered as further divisible). Of these parts it is composed, and by the variation of them the complexion or lesser whole may be varied. Because the lesser whole itself is greater or less according as more parts are included at any time, we call the number of parts or unities to be connected together at one time the exponent, after the example of a geometric progression. For example, let the whole be ABCD. If the lesser whole is to consist of two parts, for example, AB, AC, AD, BC, BD, CD, the exponent will be 2; if of three parts, for example, ABC, ABD, ACD, BCD, the exponent will be 3.

11. We shall write the complexions with a given exponent as follows: if the exponent is 2, com2nation (combination); if 3, con3nation (conternation); if 4, con4nation; etc.

12. Complexions taken simply are all the complexions computed for all exponents; for example, 15 of the number 4. These consist of 4 units, 6 com2nations, 4 con3nations, 1 con4nation.

13. A useful (useless) variation is one which can (cannot) occur because of the nature of the subject matter; for example, the four [physical] elements can be com2ned six times, but two com2nations are useless, namely, those in which the contraries fire and water and the contraries air and earth are com2ned. . . .

Problems

Three things should be considered: problems, theorems, and applications. We have added the application to individual problems wherever it seemed worth while, and the theorems also. To some of the problems, however, we have added a demonstration. Of these, we owe the latter part of the first problem, and the second and fourth, to others; the rest we ourselves have discovered. We do not know who was the first to discover them. Schwenter (*Delic*., Book i, Sec. 1, prop. 32) says they exist in Jerome Cardan, John Buteonis, and Nicolas Tartalea. But we have not found them in Cardan's *Arithmetica practica*, published in Milan in 1539. Christopher Clavius set forth especially clearly what has been found recently, in his *Commentarium in Sphaeram Joannis de Sacro Bosco*, published in Rome in 1585, pages 33 ff.[17]

Problem I

To Discover the Complexions for a Given Number and Exponent

1. There are two ways of solving this problem, one for all complexions, the other for com2nations only. The former is more general, but the latter requires fewer data, namely, only the number and the exponent, while the former also presupposes the discovery of antecedent complexions.[18]

2. We have developed the more general method; the special one is popularly known. The more general solution is this: *Add the complexions of the number preceding the given number, by the given exponent and by the exponent preceding it; the sum will be the desired complexions*. For example, let the given number be 4 and the exponent 3; add the 3 com2nations and the 1 con3nation of the preceding number 3; (3 + 1 = 4). The sum 4 will be the answer.

3. But since the complexions of the preceding number are required for this solution, Table ℵ must be constructed. In it the top line contains the *numbers* from 0 to 12 inclusive from left to right (we believe this is far enough, since it is easily extended); the vertical line at the left contains the *exponents* from 0 to 12, reading from top to bottom; and the bottom line, from left to right, contains the *total complexions* [*complexiones simpliciter*]. The lines between contain the complexions for the number given at the

head of the corresponding column and for the exponent given at the left.[19]

4. The reason for this solution, and the basis of the table, will be clear if we demonstrate that the complexions for a given number and exponent arise from the sum of the complexions of the preceding number, for both the given and the preceding exponents. Taking the given number as 5 and the given exponent as 3, the antecedent number will be 4; it will have 4 con3nations and 6 com2nations, by Table ℵ. Now the number 5 has all the con3nations of the preceding number (since the part is contained in the whole), namely, 4, and it has besides as many con3nations as the preceding number has com2nations, since the unit by which the number 5 exceeds 4, added to each of the individual com2nations of 4, will make the same number of con3nations. Thus [illegible] + 4 = 10. Therefore the complexions for a given number, etc. Q.E.D.

TABLE ℵ

	0	1	1	1	1	1	1	1	1	1	1	1	1	1	
	1	0	1	2	3	4	5	6	7n	8u	9m	10b	11e	12r	
	2	0	0	1	3	6	10	15	21	28	36	45	55	66	
	3	0	0	0	1	4	10	20	35	56	84	120	165	220	
	4	0	0	0	0	1	5	15	35	70	126	210	330	495	
Exponents	5	0	0	0	0	0	1	6	21	56	126	252	462	792	Complexions
	6	0	0	0	0	0	0	1	7	28	84	210	462	924	
	7	0	0	0	0	0	0	0	1	8	36	120	330	792	
	8	0	0	0	0	0	0	0	0	1	9	45	165	495	
	9	0	0	0	0	0	0	0	0	0	1	10	55	220	
	10	0	0	0	0	0	0	0	0	0	0	1	11	66	
	11	0	0	0	0	0	0	0	0	0	0	0	1	12	
	12	0	0	0	0	0	0	0	0	0	0	0	0	1	
	*	0	1.	3.	7.	15.	31.	63.	127.	255.	511.	1023.	2047.	4095.	
	†	1.	2.	4.	8.	16.	32.	64.	128.	256.	512.	1024.	2048.	4096.	

*The complexions taken simply (or the sum of the complexions of all given exponents), added to 1, equal the total of a geometric progression with base 2†.[20] . . .

Problem II

To Discover the Complexions Taken Simply for a Given Number

Seek the given number among the exponents of a geometric progression with base 2; then the total of complexions sought will be the number or term of the progression whose exponent is the given number, minus 1. It is difficult to understand the reason or demonstration for this, or to explain it if it is understood. The fact, however, is apparent from Table ℵ. For, when added together, and the sum added to unity, the particular complexions of a given number always constitute, when one is added, the term of that geometric progression with base 2, whose exponent is the given number. But if anyone is interested in seeking the reason for this, it will have to be found in the process of resolving used in the Practica italica, vom Zerfallen. This must be such that a given term of the geometrical progression is separated into more parts by one than there are units (i.e., numbers) in its exponent. The first of these must always be equal to the last, the second to the next to the last, the third to the third from the last, etc., until, if it is broken up into an equal number of parts, the exponent or number of things being odd, the two parts in the middle will be equal (for example, 128 or 2^7 may be broken up into eight parts according to Table ℵ: 1, 7, 21, 35, 35, 21, 7, 1); or, if the exponent is even and it must be broken into an odd number, the number left in the middle will have none corresponding to it (for example, 256 or 2^8 may be broken up into nine parts according to Table ℵ: 1, 8, 28, 56, 70, 56, 28, 8, 1). Someone may therefore think that this brings to light a new method which is absolute for solving problem 1; namely, by breaking up the complexions taken simply, or the terms of a geometric progression with base 2, by a method discovered with the aid of algebra. In fact, however, there are not sufficient data, and the same number can be broken up in several ways yet according to the same form.

Application of Problems I and II

Since everything which exists or which can be thought must be compounded of parts, either real or at least conceptual, whatever differs in kind must necessarily either differ in that it has other parts, hence the use of complexions; or by another situs, hence the use of dispositions. The former are judged by the diversity of matter; the latter, by the diversity of form. With the aid of complexions, indeed, we may discover not only the species of things but also their attributes. Thus almost the whole of the inventive part of logic is grounded in complexions—both that which concerns simple terms and that which concerns complex terms; in a word, both the doctrine of divisions and the doctrine of propositions; not to mention how much we hope to illumine the analytic part of logic, or the logic of judgment, by a diligent examination of the modes of the syllogism in Example VI.

The use of complexions in divisions is threefold: (1) given the principle of one division, to discover its species; (2) given many divisions of the same genus, to discover the species mixed from different divisions (this we will treat in Problem III, however); (3) given the species, to discover the subaltern genera. Examples are scattered throughout all of philosophy, and we will show that they are not lacking in jurisprudence. And in medicine every variety of compounded medicaments and pharmaceuticals is made by mixing various ingredients, though the greatest care is necessary in choosing useful mixtures. First, therefore, we will give examples of species to be discovered by this principle.[21]

I. Among jurisconsults the following division is proposed (Digests, Gaius, XVII, 1, 2). A mandate is contracted in five ways: in favor of the mandator, of the mandator and mandatory, of a third person, of the mandator and a third person, of the mandatory and a third person. We shall seek out the adequacy of the division in this way: its basis is the question, for whom, or the person in whose favor the contract is made; there are three of these, the mandator, the mandatory, and a third person. But there are seven complexions of three things:

Three 1nions: since contract may be in favor of only (1) the mandator; (2) the mandatory; or (3) a third person.

The same number of com2nations: (4) in favor of the mandator and mandatory; (5) of the mandator and a third person; or (6) of the mandatory and a third person.

One con3nation: (7) in favor of the mandator, the mandatory, and a third person all together.

Here the jurisconsults reject as useless that 1nion in which the contract is in favor of the mandatory alone, because this would be advice rather than a mandate. There remain thus six classes. Why they kept only five, omitting the con3nation, I do not know.

II. Aristotle (On Generation and Corruption, Book ii), with Ocellus Lucanus the Pythagorean, deduces the number of elements, or of the mutable species of a simple body, from the number of primary qualities, of which he assumes there are four, but according to these laws: (1) that every element is to be a compound of two qualities and neither more nor less, and it is thus obvious that 1nions, con3nations, and the con4nation are to be discarded and only com2nations retained, of which there are six; and (2) that contrary qualities can never enter into one com2nation and that therefore two of the com2nations are useless because there are two contraries among these primary qualities. Hence there remain four com2nations, the same as the number of elements. . . . Moreover, as Aristotle derived the elements from these qualities, so Galen derived from them the four temperaments, the various mixtures of which later medics have studied; all of whom Claudius Campensis opposed in the past century, in his Animadversiones naturales in Aristotelem et Galenum (Leyden, 1576). . . .

IV. In wind organs we call a register, in German ein Zug, a little shaft by whose opening the sound may be varied, not with respect to the perceived melody or pitch itself, but in its basis in the pipe, so that sometimes a shaking, sometimes a whisper, is achieved. More than thirty of such qualities have been discovered by the industry of our contemporaries. Assume that there are in some organs only twelve such simple effects; then there will be in all about 4,095, as many as there are complexions taken simply of twelve things. So a great organist can vary his playing as he opens them together, sometimes many, sometimes a few, sometimes these, sometimes those.

V. Thomas Hobbes, *Elementa de corpore*, Part I, chapter 5, classifies the things for which there are terms built into a proposition, or, in his own terminology, the named things [*nominata*] for which there are names [*nomina*], into *bodies* (that is, substances, since for him every substance is a body), *accidents*, *phantasms*, and *names*. Thus a name is a name either of bodies, for example, man; or of accidents, for example, all abstractions, rationality, motion; or of phantasms, in which he includes space, time, all sensible qualities, etc.; or of names, in which he includes second intentions. Since these are com2ned with each other in six ways, there arise the same number of kinds of propositions, and adding to these the cases in which homogeneous terms may be com2ned (a body ascribed to body, accident to accident, phantasm to phantasm, secondary concept to secondary concept), namely, four, the total is ten. Out of these Hobbes thinks that only homogeneous terms can be usefully com2ned. If this is so, as the common philosophy certainly also acknowledges, and abstract and concrete, accident and substance, primary and secondary concepts, are wrongly predicated of each other, this will be useful for the art of discovering propositions or for observing the selection of useful com2nations out of the uncountable mixture of things. . . .

VIII. The eighth application is in the formation of cases by the jurisconsults. For one cannot always wait for the lawmaker when a case arises, and it is more prudent to set up the best possible laws without defects, from the first, than to intrust their restriction and correction to fortune; not to mention the fact that, in any state whatsoever, a judicial matter is the better treated, the less is left to the decision of the judge (Plato *Laws*, Book ix; Aristotle Rhetoric, Book i; Jacob Menochius, De arbitrariis judicum questionibus et causis, Book i, proem. 1).

Moreover, the art of forming cases is founded in our doctrine of complexions. For as jurisprudence is similar to geometry in other things, it is also similar in that both have elements and both have cases. The elements are simples; in geometry figures, a triangle, circle, etc.; in jurisprudence an action, a promise, a sale, etc. Cases are complexions of these, which are infinitely variable in either field. Euclid composed the Elements of Geometry, the elements of law are contained in the Corpus Juris, but in both works more complicated cases are added. The simple terms in the law, however, out of the combinations of which the rest arise, and, as it were, the loci communes and highest genera, have been collected by Bernhard Lavintheta, a Franciscan monk, in his commentary on the Ars magna of Lully (which see). To us it seems thus: the terms from whose complexions there arises the diversity of cases in the law are persons, things, acts, and rights. . . .

The basis of terms is the same in theology, which is, as it were, a kind of special jurisprudence, but fundamental for the same reason as the others. For theology is a sort of public law which applies in the Kingdom of God among men. Here the unfaithful are like rebels; the church is like good subjects; ecclesiastical persons, and indeed also the political magistrate, are like the subordinate magistrates; excommunication is like banishment; the teaching of Sacred Scripture and the Word of God is like that of the laws and their interpretation; that of the canon like the question of which of the laws are authentic; that of fundamental errors like that of capital crimes; that of the Final Judgment and the Last Day like that of the judiciary process and the rendered judgment; that of the remission of sins like that of the pardoning power; that of eternal punishment like that of capital punishment, etc. . . .

2

A NEW METHOD FOR LEARNING AND TEACHING JURISPRUDENCE

1667

Revision Notes, 1697-1700

(Selections from Part I)

Written on his journey from Nürnberg to Frankfurt in 1667, this study of the psychology of learning, the organization of knowledge, and the logical bases of law was designed to attract the attention of John Philip of Schönborn, the elector of Mainz and political leader of the relatively independent Rhenish confederation, and to secure for Leibniz a position at his court. This it eventually succeeded in doing, and Leibniz was appointed in 1668 to work with Herman Andrew Lasser in revising the legal code (No. 7).

Part I, from which these selections are taken, develops a psychology and philosophy of education which is Aristotelian and therefore functional in conception. It includes also a logical analysis of the fields of learning. Part II, here omitted, is devoted to an analysis of the law, its philosophical foundations, and a program for teaching it. Its discussion of the three levels of natural right and justice is essentially the same as the later form in Nos. 43 and 58.

In the last years of the century, Leibniz undertook a revision of this early work. His more important revision notes are given in footnotes, to show the similarity of many of his early with his more mature views.

* * *

PART I

GENERAL AND COMMON TO ALL FACULTIES: ON A BASIS FOR STUDIES IN GENERAL

[PA., VI, i, 266-72]

1. By a basis for studies we mean a certain kind of reasonable order; that is, a method for arriving at a state of perfected actions.

2. This state is called habit, which I define as a permanent but acquired readiness to act.

3. A subject of habit is whatever is capable of action. For it is a fact that even inanimate things can be habituated to certain actions. Thus chemists restore the most volatile spirit of wine [alcohol] by many circulations and agree in teaching that metals themselves will pass over the alembic by many distillations and cohobations with a menstruum.[22] In the _Elementa de corpore_ Thomas Hobbes teaches that by frequent bending metal leaf acquires the habit of a kind of resilience.

4. No one who has read the booklet of Rorarius: _That beasts use reason better than man_, or Pliny's wonderful study of the elephant rope-dancer, or the praise of elephants and dogs in Lipsius' _Letters_ can doubt that beasts are teachable.[23] A recent exhibit in Vienna of horses dancing in a ring makes these things all the more credible.

5. Since infants differ but little from beasts in their early years as to their external use of reason, their teachers may conveniently borrow some things from the trainers of animals. For the masters of horses, dogs, and birds have their own peculiar devices for teaching them to speak, hunt, or sing.

6. In general, however, the instrument they use is food—plenty when the animals obey, none when they refuse. . . . So it is said that the people of the Balearics offered no food to boys until they had completed their assigned tasks. And "teachers give boys sweet cakes, so that they will want to learn first principles." From

this custom there remains in some boarding schools a punishment by hunger—das Cariren.

7. This device may be used with children but not with freer minds who are already making more use of reason. In place of bodily food, these must be offered the food of the mind, namely, honor. Hence there has arisen a system of classes and places in the lower schools and of promotions in the universities. In ancient times those boys who were unusually outstanding were led home by the rest with acclamations, as we know from the example of Cicero.

8. So much for the subject of habits. The cause or method by which a habit is acquired is either supernatural infusion or natural practice. In sentient beings, insofar as they are sentient, the latter is called teaching.

9. Infusion is either divine or diabolical. We have an example of divine infusion in the apostles' gift of tongues, although this is in fact not thought to have lasted beyond the ecstasy itself and was therefore not a habit, since it was not permanent. In church history we have a similar example in St. Ephraim the Syrian, who suddenly received a knowledge of the Greek language through the prayers of Basil the Great. Examples of diabolic infusions are not lacking in his slaves.[24] Nor need we think that divine infusion is entirely lacking in our own times; we implore the divine blessing on our own studies to this end.

10. From infusion let us proceed to practice. This is done by means of the quantity of impressive action. But quantity is either extensive or intensive; extensive quantity consists in the number of actions, intensive in the magnitude or the strength required to impress the habit. The earlier requirement is popularly recognized when people say that habit is built by frequent actions; on the latter people are usually silent.

11. The effectiveness of number or frequency is popularly confirmed in the proverb: Add little to little, and you gather a great pile. And Ovid says:

Gutta cavat lapidem, consumitur annulus usu,
Et teritur pressa vomer aduncus humo.

Aesop's tortoise, who is quicker than the eagle, applies here, as does the German proverb: "Wer langsam geht kommt auch nach."[25] From this principle arises the human device of attacking in parts a matter which cannot be mastered if attacked as a whole. We break marble by filing, carry off mountains in baskets, and empty cisterns with buckets. So we compute vast sums by parts in arithmetic, and in geometry we divide areas into triangles.

12. From this principle arises the necessity of repetition, upon which permanence, the ultimate essential of habit, largely depends. For we learn by practice to accept and dismiss some figures quickly, like a wax tablet, and others slowly, like a bronze one. Likewise, some people accept and reject the flames of rage quickly, like straw, and others slowly, like burning iron. Hence the Pythagoreans held that no one should fall asleep before "he had reviewed all of his deeds for the whole day." For it is harmful to spread out repetition too far through the year, as is commonly done in schools. But daily studies may advantageously be summarized just before night, and then at the end of seven days, and again at the end of a month. Then all the months can be summarized at the end of the year, and so what is most important may be reviewed on separate levels. I am not aware that anyone has made this observation before. . . .

14. So much for frequency of action; we proceed to intensity or magnitude. One act carried out with a distinctive force of impression often accomplishes more than many repetitions. For example, we easily remember unusual facts, unexpected jokes, and acts that are uniquely related to our own interest, such as those which bring us praise or blame. . . .

15. It is best, however, to mix frequency with magnitude. This happens especially when action begins with the smallest and is increased continuously and by degrees until it reaches a maximum. Chemists prescribe this in applying fire to the alteration of inani-

mate things. Milo of Croton is said to have hardened himself through an artifice of this kind. Every day he carried a calf a certain distance, so that, as the calf's weight increased, his strength also insensibly increased, until at last he carried a bull in the Olympic games. The art of drinking can be taught on the same basis, if one increases his capacity by a glass as often as each week. So the Frenchman who saw some Germans at the mineral springs of Swalbach, getting used to drinking more and more water by betting with each other, thought that this was a drinking game, a Sauffschule, in which the Germans learned with water the art in which they were to excel with wine. . . . The same principle is most useful in memorizing a speech verbatim; the first phrase is read off first, then the first and second together, then the first, second, and third, etc. This device is also used in some girls' games. It is remarkable how easily the whole is memorized on this basis. The stern reader will forgive me for using these trifling examples, if trifles help us to be more skilful in serious instruction.

16. So much for habituation or the cause of habits, even when the common sense is lacking.[26] We must now come to teaching. To teach is to form a habit in a sentient being as such, or through his sense. Hence this art as a whole is called didactic. For even those who learn by themselves teach themselves; hence the name autodidact.

17. Teaching is to the soul as medicine is to the body of an animal. Just as the physician aims to heal (1) carefully, (2) swiftly, and (3) pleasantly, so the same things are required in the care of the soul; teaching should be (1) sound, (2) swift, and (3) pleasant. . . .

18. . . . Frequency of action makes teaching firmly implanted; magnitude makes it quickly implanted. These causes are common to animate and inanimate habits, and enough has been said about them.

19. But the last aim, to teach pleasantly, applies only to animate beings and must be discussed here. For there is a unique

basis for habituation in animals, which makes them more capable of receiving instruction because they experience pleasure when they excel and grief when they stop up their ears. In beasts this is accomplished by food and petting, in man by utility (his food, as it were) and honor (his petting). But we have already discussed these in Sections 6 and 7.[27]

20. Learning is pleasant, moreover, not only if the ends proposed are pleasant, but also if the methods of learning are pleasant. . . .

21. We have spoken, first, of the cause of habit common to inanimate things, beasts, and men, namely, habituation (from Secs. 10 to 15); then of the cause of habit common only to beasts and men, namely, teaching. It remains to discuss the cause of habit distinctive of men, education by principles.

22. Habits proper to men are either of memory, of invention, or of judgment. Hence there is a threefold doctrine of these habits —mnemonics, topics, and analytics. For propositions, which are of course distinctive of men only, can be memorized, made, or judged. Topics and analytics, moreover, are to be combined in the single term logic, so that the parts of didactics are mnemonics and logic. Methodology may well be added to these. Mnemonics establishes the matter, methodology the form, and logic the application of form to matter.

23. The basis of mnemonics is some perceptible thing called a sign, which is joined by a definite relation to the thing to be remembered. This relation is either one of comparison—namely, similarity or dissimilarity—or one of connection—such as that of whole and part, part and part, cause to effect, and sign to thing signified. Thus words are invented because it would otherwise be most difficult for men to remember things. Words are not merely signs of my present thoughts to others but are also signs of my past thoughts to myself, as Thomas Hobbes has shown at the beginning of his Elementa de corpore.[28] Those signs are most mnemonic, moreover, which are most perceptible, so to speak, such as words which

are not merely heard but are heard with joy—for example, songs and the termini clappantes, as they are commonly called, which boys put together with great fitness in learning their vocabularies. . . .

24. The basis of the topics, or the art of invention, is the loci, that is, transcendent relations such as whole, cause, matter, similarity, etc. As we have shown in our Dissertation on the Art of Combinations, propositions are made from things connected by any such relation through the combinatorial art. The contributions made to this subject by Raymund Lully in various works and by Henry Bisterfeld in his Epitome of the Art of Thinking are also not to be despised.[29]

25. Analytics, or the art of judging, seems to me to be almost completely reducible to two rules: (1) no word is to be accepted without being explained, and (2) no proposition is to be accepted without being proved. These I believe to be far more absolute than the four Cartesian rules in the First Philosophy,[30] the first of which is that whatever I perceive clearly and distinctly is true. This is deceptive in endless ways.

26. Methodology, or the art of arranging, turns about method. A method is either natural, in which case the rule is that if one thing can be known without a second, but the second cannot be known without the first, the first should be put before the second; or it is occasional, in which case no rule can be given, since such cases vary in endless ways. . . .[31]

31. Now follow the habits of the mind. Every action of the mind is thought, for to will is nothing but to think of the goodness of a thing.[32] Furthermore, all thinking is of some proposition. For mere simple terms are found only among beasts; the sense perception [imaginatio][33] of man is never without some reflection.

32. Every proposition is either singular (hence history; for example, a magnet holds up the iron casket of Mohammed in Mecca —assuming for the sake of example that this is true); or it is contingent and universal, depending on induction from singular propo-

sitions (hence observation; for example, a magnet lifts iron); or it is necessary and universal, demonstrable from the terms themselves (hence science; for example, whatever moves is moved by some other thing, or, if a magnet lifts iron, there must be corporeal effluvia passing from the magnet to the iron).[34]

32a. Hence history is the mother of observation. On its nature, constitution, and classification Francis Bacon of Verulam is excellent in his incomparable treatise De augmentis scientiarum and no less so in the brilliant Novum organum scientiarum. The same materials involve history, observation, and theorems, science being the combination of these. For example: History: The wife of Fabius Maximus, who lived under Augustus Caesar, was garrulous. Observation, topical: Women are garrulous. Theorem or maxim: Do not trust a garrulous person with a secret. So we classify propositions in general, not on the basis of the copula and signs, as in section 31, but on the basis of their terms.

33. Terms are either simple or composite. Simple terms are those which cannot be made clear by more familiar terms, because they are given immediately to sense, that is, they are themselves sensible qualities. That which has sensible qualities, or is perceptible, is called a being. This is the most perfect definition of being, for whenever we wish to prove that something is, we do so by the fact that we or others sense it either in itself, by immediate sensation, or mediated by the sensation of something else which cannot be without it. Qualities taken together at the same time (or imaginability) constitute essence; sensibility constitutes existence. From the thought of many beings taken together there arise relations or the affections of being.[35] For the following kinds of comparison arise from co-imaginability or co-essence: the same, different, similar, dissimilar, contrary, genus, species, universal, singular. But from consensibility or coexistence there arise the following forms of connection: whole, part, order, one, many, necessary, contingent, togetherness, cause, etc. Universal metaphysics grows from this.[36]

34. Sensible qualities are of two kinds: some perceived in the mind alone, others in fantasy or by means of mediating bodily organs. In the mind are perceived only two sensible qualities: thought and causality.[37] Thought is a sensible quality either of the human intellect or of something "I know not what" within us which we observe to be thinking. But we cannot explain what it is to think any more than what white is or what extension is. We conclude by demonstration that this quality is also in God and the angels. Upon the sensible quality called thought is built logic, which is after metaphysics the most noble science and one which Aristotle carried over by demonstration into mathematical form.

35. The other sensible quality found in mind alone is causality—when it can be proved demonstratively from an effect that it has some cause, even though latent.[38] This quality, abstracted from others such as motion and figure, is in the world cause or God, as well as in the causes of certain miracles in the world, or angels, and, finally, in our own minds[39] as the cause of bodily motion. But we cannot explain the method of causality. This is the subject matter of pneumatics, which deals with the external actions of incorporeal being, as logic deals with their internal actions, or thought. Here belongs also practical philosophy, or the doctrine of the pleasant and the useful, and of justice or what is of common value in a community. To it belongs also the demonstration of the existence of God and of his attributes, of angels, and of an incorporeal mind or immortal soul within us. My own thinking has arrived at mathematical certainty in these matters through a remarkable principle which I hold to be far more important for tranquillity of mind and faith in eternal life than if I had discovered perpetual motion or the quadrature of the circle.

36. Qualities mediated by corporeal organs are either sensible or common to many organs. The latter are number, which is perceived by all the external senses and is the basis of arithmetic, and extension[40] with its various modes, which are perceived by sight and touch only and are the basis of geometry. Whatever has

another sensible quality besides extension and number is called body. Whatever does not have this added quality is called a vacuum. Here physics arises.[41] The most simple sense is touch, however, through which we perceive motion. The general problem of physics is the explanation of motion, because, as we shall show next, there is nothing in the other qualities but a subtle motion, by which they can all be explained, if we assume extension. There are also special qualities of touch, such as solidity, fluidity, tenacity, smoothness, etc. Facts should be gathered most diligently about these, and also about light and colors, sounds, odors, and tastes, so that their causes in matter and motion may be better known.

37. The abstract philosophy of qualities is followed by a concrete philosophy about the things into which these qualities coalesce. Here the qualities of things are surveyed empirically and recounted; nothing is proved anew but merely subsumed from what was previously demonstrated in the abstract philosophy. Here we are concerned with God, angels, and our mind; with fire, vapors, meteors, water, and various kinds of liquids; with earth and minerals, plants, and animals. Here then we survey, not the connection of qualities to each other and to their subjects, but the connection of subjects with qualities. This part of philosophy can be called eidographic; the preceding part, poiographic.

38. Finally, we conclude with cosmography, in which the connection of subjects to each other is expounded, and how they are distributed in the world. . . . Now I am sure that I have exhausted everything in my classification of the disciplines and have outlined the elements of the sciences briefly but soundly.[42] . . .

3

Letter to Jacob Thomasius

April 20/30, 1669[43]

Jacob Thomasius had been one of the more influential of Leibniz's teachers at Leipzig. Though he seems to have lectured only on rhetoric while Leibniz was in the university, he supervised his first dissertation, De principio individui; and the letters which Leibniz wrote to him after leaving Leipzig show the high respect which the pupil had for his master.

Leibniz's intention of reconciling the ancient and the new philosophy appeared early in his thought. This letter contains an effort to show Aristotle consistent with the modern philosophers rather than with the Scholastics. It was evoked by his comment on Thomasius' Origines historicae philosophiae et ecclesiasticae, which appeared in 1665 and was for long one of the most accurate histories of ancient philosophy.

Leibniz thought well enough of this letter to have it printed at the end of his preface to the Nizolius edition in 1670 (No. 8), in which related matters were discussed. The letter is here translated in the form in which Thomasius received it, with the exception of certain obscure passages which even he apparently could not understand.[44] At these points substitutions have been made from the version of 1670.

* * *

[G., I, 15-27; IV, 162-74]

The "foretaste" of a history of philosophy which you have written has set all our mouths to watering more than I can tell you, for it shows clearly how great a difference there is between a mere enumeration of names and such profound reasons as you give for the interconnections between doctrines. You know that I am no flatterer. But wherever I hear people who understand these matters speak of your essay, they are unanimous in saying that there is no one from whom we can better hope for the entire history of philosophy than from you. Most of the others are skilled rather in antiquity than in science and have given us lives rather than doctrines. You will give us the history of philosophy, not of philosophers. Joseph Glanvill's history of the growth of the sciences since Aristotle is said to be in press in England.[45] But I believe that, in general, he will trace only the mathematics, mechanics, and physics of the more noteworthy periods and so detract nothing from you. I wish, indeed, that you would produce both a style and a method [stilum filumque] for this new age and warn our unseasoned youth that it is wrong to give our moderns credit either for everything or for nothing. Baghemin is not the only one whom you ought to criticize;[46] there are Patricius, Telesius, Campanella, Bodin, Nizolius, Fracastori, Cardan, Galileo, Bacon, Gassendi, Hobbes, Descartes, Basso, Digby, Sennert, Sperling, Derodon, Deusing, and many other names among whom the mantle of philosophy is torn apart. It will be play for you, but fruitful for the public, to remind the world of them.

Who would disagree with your estimate of Baghemin?[47] There is no elegance in his hypotheses, no consistency in his reasoning, but only utterly monstrous opinions. Unless he has something useful to say in specific physical observations, certainly he had better remain silent. It seems to me that the parents of his opinion that God is primary matter are Scaliger, Sennert, and Sperling—for he professes also to be a disciple of the latter—who affirm that forms are produced, not from the passive power of matter, but from the active power of an efficient cause. From this they conclude that God produces creatures rather from his own active power than from the objective and, so to speak, passive power of nothing. In their opinion, therefore, God produces things out of himself and is thus the primary matter of things. But you will judge more correctly on this subject.

I agree with you completely in regard to Descartes and Clauberg, that the disciple is clearer than the master. But, on the other hand, I should venture to say that hardly any of the Cartesians have added anything to the discoveries of their master. Certainly Clauberg, Raey, Spinoza, Clerselier, Heerbord, Tobias Andreae, and Henry Regius have published only paraphrases of their leader. However, I am calling Cartesians only those who follow the principles of Descartes; such great men as Bacon, Gassendi, Hobbes, Digby, and Cornelius van Hoghelande,[48] who are commonly confused with the Cartesians, are definitely to be excluded from their number, since they were either equals or even superiors of Descartes in age and in ability. As to myself I confess that I am anything but a Cartesian. I maintain the rule which is common to all these renovators of philosophy, that only magnitude, figure, and motion are to be used in explaining corporeal properties. Descartes himself, I hold, merely proposed this rule of method, for, when it came to actual issues, he completely abandoned his strict method and jumped abruptly into certain amazing hypotheses. Vossius rightly criticizes him for this in his book on light.

Hence I do not hesitate to say that I approve of more things in Aristotle's books on physics[49] than in the meditations of Descartes; so far am I from being a Cartesian! In fact, I venture to add that the whole of Aristotle's eight books can be accepted without injury to the reformed philosophy. This by itself meets your arguments about the irreconcilability of Aristotle and the moderns. For the most part Aristotle's reasoning about matter, form, privation, nature, place, infinity, time, and motion is certain and demonstrated, almost the only exception being what he said about the impossibility of a vacuum and of motion in a vacuum. For to me it seems that neither a vacuum nor a plenum is necessary; the nature of things can be explained in either way. Gilbert, Gassendi, and Guericke argue for a vacuum; Descartes, Digby, Thomas White, and Clerke in his book on the plenitude of the world, for a plenum; Thomas Hobbes and Robert Boyle for the possibility of either. I admit that the rarefaction of things is difficult to explain without a vacuum, though it is possible.[50] I have recently seen a book by Jean Baptiste du Hamel, a learned Frenchman, on the agreement of the old philosophy and the new, which was published lately in Paris. In it he brilliantly explains the hypotheses of some of the best-known ancient and recent thinkers and often criticizes them with discernment. He also says a good bit about the divisions of opinion concerning the vacuum.

For the rest, scarcely any sane man will question the many other arguments of Aristotle in his eight books on physics and in the whole of his metaphysics, logic, and ethics. Who would disagree, for instance, with his theory of substantial form as that by which the substance of one body differs from that of another? Nothing is more true than his view of primary matter. The one question is whether Aristotle's abstract theories of matter, form, and change can be explained by magnitude, figure, and motion. This the Scholastics deny and the philosophical reformers affirm. The latter opinion seems to me to be not only the more true but also the more consistent with Aristotle. Let me discuss each briefly.

First, about Aristotle. The Scholastics have strangely perverted his meaning; no one knows this better than you, distinguished Sir, who were the first to bring many errors of this kind to light. Since not only you acknowledge this, but also Soner and Dreier in metaphysics, Viotti, Zarabella, and Jung in logic, and Jason Denores, Piccart, Conring, Felden, Durr, and many others in civil law; why, I ask, shall we not expect the same or even worse in physics, where aid must be sought from the senses, from experience, and from mathematics—instruments which the Scholastics, shut up in their monasteries, lacked almost entirely? It is therefore probable enough that they were wrong in physical matters; what if I show that it is even more, namely, certain? This can be done in two ways. It can be shown either that the reformed philosophy can be reconciled with Aristotle's and does not conflict with it or, in addition, that the one not only can but must be explained through the other, nay, that the very views which the moderns are putting forth so pompously are derived from Aristotelian principles. The former way establishes the possibility of their being reconciled; the latter, the necessity. But if the reconciliation is shown to be possible, it is by that fact also accomplished. Even if the interpretations of both Scholastics and moderns were possible, the clearer and more intelligible of two possible hypotheses must always be chosen, and without any doubt this is the hypothesis of the moderns, which conceives no incorporeal entities within bodies but assumes nothing beyond magnitude, figure, and motion. I cannot better show this possibility of reconciling the two than by asking for any principle of Aristotle which cannot be explained by magnitude, figure, and motion.

Primary matter is mass itself, in which there is nothing but extension and antitypy or impenetrability.[51] It has extension from the space which it fills. The very nature of matter consists in its being something solid and impenetrable and therefore mobile when something else strikes it, and it must give way to the other. Now this continuous mass, which fills the world while all its parts are at rest, is primary matter, from which all things are produced by motion and into which they are reduced through rest. There is no diversity in it but only homogeneity, except through motion. Hence all the knots of the Scholastics are already untied. First, they ask about its entitative actuality prior to all form. The reply must be that it is a being prior to all form, since it has its own existence. For whatever is in some space exists, and this cannot be denied of mass itself, even if it entirely lacks motion and discontinuity. But the essence of matter or the very form of corporeity consists in antitypy or impenetrability. Matter has quantity too, though this is indefinite, or interminate as the Averroists call it. For being continuous, it is not cut into parts and therefore does not actually have boundaries. But it does have extension or quantity. Everything fits together wonderfully, not as concerns the extrinsic limits of the world or the mass as a whole, but as concerns the intrinsic limits of its parts.

Let us pass from matter to form in good order [*per dispositiones*]. Here too everything agrees remarkably if we assume that form is nothing but figure. For since figure is the boundary of a body, a boundary is needed to introduce figure into bodies. But a discontinuity of parts is necessary in order to have a variety of boundaries arising in matter. For by the very fact that parts are discontinuous, each one will have separate boundaries, since Aristotle defines the continuum as things whose limits are one [ὧν τὰ ἔσχατα ἕν].[52] But discontinuity can be introduced into the formerly continuous mass in two ways—first, in such a way that contiguity is at the same time destroyed, when the parts are so pulled apart from each other that a vacuum is left; or in such a way that contiguity remains. This happens when the parts are left together but moved in different directions. For example, two spheres, one included in the other, can be moved in different directions and yet remain contiguous, though they cease to be continuous. This makes it clear that, if mass were created discontinuous or separated by emptiness in the beginning, there would at once be certain concrete forms of matter. But, if it is continuous in the beginning, forms must necessarily arise through motion. (I am not now speaking of the annihilation of certain parts to secure a vacuum in matter, since this is supernatural.) For division comes from motion, the bounding of parts comes from division, their figures come from this bounding, and forms from figures; therefore, forms come from motion. From this it is clear that every arrangement into a form is motion, and the vexatious problem of the origin of forms is answered. The distinguished Herman Conring could only answer to this problem, in a special dissertation, that forms arise from nothing.[53] We shall say that they arise from the power of matter, not by producing something new, but merely by taking away something old and causing boundaries through a division of parts, just as anyone who makes a column does nothing but remove the superfluous parts. What is left after the rest has been removed takes on, by this very fact, the figure which we call a column. For all the figures or forms which are contained in the mass lack only determination and actual separation from the others which adhere to them. If this explanation is adopted, all the arguments advanced against the origin of forms from the power of matter itself become child's play and trifles.

It now remains for us to come to change. Changes are commonly and rightly classed as generation, corruption, increase, decrease, alteration, and change of place or motion.[54] Modern thinkers believe that these can all be explained by local motion alone. In the first place, the matter is obvious in the case of increase and decrease, for change of quantity occurs in a whole when a part changes its place and is either added or taken away. We need only to explain generation, corruption, and alteration through motion. I observe in advance that numerically the same change may be the generation of one being and the alteration of another; for example, since we know that putrefaction consists in little worms invisible to the naked eye, any putrid infection is an alteration of man, a generation of the worm. Hooke shows similarly in his Micrographia that iron rust is a minute forest which has sprung up; to rust is therefore an alteration of iron but a generation of little bushes. Moreover, generation and corruption, as well as alteration, can be explained by a subtle motion of parts. For example, since white is what reflects the most light and black is what reflects the least, those things whose surfaces contain many small mirrors will be white. This is why foaming water is white, for it consists of innumerable little bubbles, and each bubble is a mirror, while, before, the water as a whole was but one mirror—just as there are as many mirrors as there are fragments when a glass mirror is broken. This is also why pounded glass is whiter than when it is intact. Similarly, water broken into distinct mirrors by bubbles therefore becomes white, and this is also the reason why snow is whiter than ice, and ice than water. For it is false that snow is condensed water; it is rather rarefied and therefore is lighter than water and occupies more space. The sophism of Anaxagoras about black snow is to be refuted in this way. Such considerations make it clear that colors arise solely from a change of figure and position in a surface. If we had space, it would be easy to explain light, heat, and all qualities in the same way.

Now if qualities are changed by motion alone, substance will also be changed by that very fact, for a thing ceases to be if all, or even some, of the qualities requisite to it are changed. For example, if you remove either light or heat, you destroy fire. And you accomplish both by stopping motion. This is why a covered fire will die for lack of the air which feeds it, not to speak of the fact that an essence differs from its qualities only in relation to sense. Just so, the same city presents one aspect if you look down upon it from a tower placed in its midst; this is as if you intuit the essence itself. The city appears otherwise if you approach it from without, which is as if you perceive the qualities of a body. And just as the external aspect of a city varies as you approach it differently, from the west or from the east, the qualities of a body vary with the variety of our sense organs.[55] From this it is evident that all changes can be explained by motion.

It is no objection that generation occurs in an instant while motion involves succession, for generation is not motion but the end of motion; the motion is already finished at that instant, for a certain figure is produced or generated at the very last instant of motion, as a circle is produced in the final moment of a revolving motion. This also makes clear why the substantial form consists in something indivisible and cannot be increased or decreased. For neither can a figure be increased or decreased. Even if one circle is greater than another, one circle is not more circle than another, for the essence of a circle consists in the equality of all lines drawn from its center to its circumference. But equality itself consists in an indivisible; nothing can be more or less equal. Nor should the objection be made that figure and magnitude are accidents, for they are not always accidents. Fluidity may, for example, be an accident of lead, for lead flows only in fire, but it belongs to the essence of mercury. Now the cause of fluidity is undoubtedly the free curved figure of parts, whether they be spherical, cylindrical, oval, or spheroid. Therefore the curved figure of its subtle parts is an accident of lead, but essential to mercury. The reason for this is that all metals arise from mercury fixed by salts, while the nature of salts consists in rectilinear shapes adapted to rest. Thus if we dissolve salts in water and let them crystallize freely, some crystals appear as tetrahedrons, others as hexahedrons, octahedrons, etc., as chemists know, but none appears round or curvilinear. Hence the salts are the cause of fixity, and the acid salts mixed with the smallest parts of mercury in the bowels of the earth impede the freedom of the curvilinear parts by inserting themselves between them and produce metal. But in fire the metal returns to the nature of mercury, for fire, inserting itself between the smallest parts, frees the curvilinear particles of mercury from the plane-sided salts; hence metal flows in the fire. So there is obviously almost nothing in Aristotle's physics which cannot be readily explained and made clear through the reformed philosophy.

These examples, moreover, have occurred to me spontaneously while writing this; others are collecting many more throughout the whole of natural philosophy. I have no fear that you will ascribe what I have said to my following too closely the accounts and authority of Raey.[56] I had thought this way long before I had even heard of Raey. I have read him, of course, but in such a way that I now scarcely recall what he said. Nor is he the first or the only one to reconcile Aristotle with modern philosophy. Scaliger seems to me to have paved the way, and in our own times Kenelm Digby and his follower Thomas White—the former in a book on the immortality of the soul, the latter in his peripatetic institutions—have dealt explicitly with the same thing, long before Raey. Abdias Trew and particularly Erhard Weigel are in harmony with them.[57]

So far it has been shown only that the two positions can be reconciled; it still remains to show that they ought to be. For what does Aristotle discuss, in the eight books of the Physics, besides figure, magnitude, motion, place, and time? If the nature of body in general can be explained in terms of these, then the nature of a particular body must be explained in terms of a particular figure, a particular magnitude, etc. In fact, he himself says in the Physics, Book iii, Section 24, that all natural science concerns magnitude (with which figure is, of course, associated), motion, and time. He also says, repeatedly, that the subject of physics is movable bodies and that natural science deals with matter and motion. He does, it is true, make the heavens the cause of all that takes place in the sublunary realm. But the heavens, he says, act on the inferior realms only through motion. Moreover, motion produces only motion or the limits of motion, which are magnitude and figure, and from these result position, distance, number, etc. Everything in nature must therefore be explained through these. This same Aristotle says frequently, as, for instance, in the Physics, Book i, Section 69, that the relation of bronze to the statue is the same as that of matter to form.

For the rest, I have proved that figure is a substance, or rather that space is a substance and figure something substantive, because all science deals with substance, and it cannot be denied that geometry is a science. You have replied that you can produce a passage in which Aristotle denies that geometry is a science more quickly than I can produce one in which he affirms that it is. I have no doubt, distinguished Sir, that there are certain passages in Aristotle which can be stretched or twisted to this end. Yet I think that these are outweighed by countless other admissions of his. For what occurs more frequently in all the books of the Analytics than examples from geometry? He seems to have intended geometric demonstrations to serve as patterns for the rest, so to speak. Now it would be absurd to make the less noble a pattern for the more noble. The Scholastics, in fact, thought so meanly of mathematics at first that they made every effort to exclude it from the number of the perfect sciences, chiefly on the ground that it does not always demonstrate from causes. But, if we consider the matter more accurately, it will be seen that it does demonstrate from causes. For it demonstrates figures from motion; from the motion of a point a line arises, from the motion of a line a surface, from the motion of a surface a body. The rectangle is generated by the motion of one straight line along another, the circle by the motion of a straight line around an unmoved point, etc. Thus the constructions of figures are motions, and the properties of figures, being demonstrated from their constructions, therefore come from motion, and hence, a priori, from a cause. Geometry is thus a true science, and, Aristotle not to the contrary, its subject, which is space, is a substance.

Nor is it so absurd that geometry should deal with the substantial form of bodies. For note the passage in Aristotle's _Metaphysics_, Book xiii, Section 3, in which he says expressly that geometry disregards material, final, and efficient cause; this being assumed, it follows that it deals either with substantial or with accidental form. But it does not deal with accidental form, since the real definition of an accidental form involves a subject in which it inheres, or matter. But Aristotle says that geometry disregards matter. Therefore geometry deals with substantial form. So there occurs to me, as I write this, a beautiful harmony among the sciences; namely, that under careful examination it appears that theology or metaphysics deals with the efficient cause of things, or mind; moral philosophy, whether ethics or law (for as I learned from you, these are one and the same science), deals with the final cause of things, or the good; mathematics (I mean pure mathematics, for the rest is a part of physics) deals with the form or idea of things, or figure; physics deals with the matter of things and the unique affection resulting from the combination of matter with the other causes, or motion. For mind supplies motion to matter in order to achieve a good and pleasing figure and state of things for itself. Matter in itself is devoid of motion. Mind is the principle of all motion, as Aristotle rightly saw.

For to come to this problem, Aristotle seems nowhere to have imagined any substantial forms which would themselves be the cause of motion in bodies, as the Scholastics understood them.[58] He does indeed define nature as the principle of motion and of rest and calls form and matter nature, though form more so than matter. But from this it does not follow, as the Scholastics contended, that form is a kind of immaterial being, though insensible in bodies, which spontaneously imparts motion to a body, for example, downward motion to a stone, without the help of an external thing. For form is indeed the cause and principle of motion, but not the primary one. No body moves unless it is moved from without, as Aristotle not only rightly says but demonstrates. For example, assume a sphere to be on a plane. If it is once at rest, it will not move by itself in all eternity, unless an external impulsion is added, for example, another body. In that case the other body is the cause of the impressed motion, while the sphere's figure or sphericity is the cause of the received motion, for if this sphericity had been absent, perhaps for this occasion only, the body would not give way so easily to the other one. This shows that the Scholastic concept does not follow from the Aristotelian definition of form. I admit therefore that form is the principle of motion within its own body, and that body is itself the principle of motion in another body. But the first principle of motion is the primary form, which is really abstracted from matter, namely, mind, which is at the same time the efficient cause. Hence freedom and spontaneity belong only to minds. Therefore it is not absurd that of the substantial forms only mind should be designated as the first principle of motion, all the others receiving their motion from mind. And as I said, Aristotle regards it as certain that no body has a principle of motion within itself alone,[59] and it is by this argument that he ascends to the prime mover.

You make two answers to this objection. First, that this argument has no effect against Epicurus, who ascribes spontaneous downward motion to his atoms. I admit that the argument has no effect against him unless it be first proved to him that it is absurd and impossible for a body to receive motion from itself, a thing which Cicero has already done, if I am not mistaken, in his books on the nature of the gods, where he elegantly ridicules Epicurus for introducing something into his hypothesis in this way, without cause or reason. For there is[60] no "downward" in the nature of things, but only in relation to us, nor is there any reason why any body should move in one direction rather than another. So we shall easily reply to Epicurus when he denies that whatever moves is moved by something external to itself and vindicate the certainty which we seek for the existence of God.

Your second objection is that Aristotle seems to have reasoned not so much from the axiom that the principle of motion is outside the body which is moved but rather from another, that there is no infinite progression. But consider carefully, honored Sir, whether he does not in fact need the combination of both. For unless it be admitted that whatever moves is moved from without, we shall obviously arrive at no progression at all, to say nothing of one to infinity. For your adversary will attack your very beginning and respond that any given body suffices to produce its own motion through its substantial form and that hence no mover is necessary, certainly not a prime mover. So the ladder would collapse at the very bottom step, its foundation, as it were, removed. Furthermore, Epicurus too admitted an infinite progression; so we must consider not so much what Epicurus did or did not admit but what can be demonstrated with certainty.[61]

Now that we have reconciled the reformed philosophy with Aristotle, it remains to show its truth per se in the same way that the Christian religion can be proved by reason and experience as well as from sacred scripture. It must be proved that there are no entities in the world except mind, space, matter, and motion. A thinking being, I call mind. Space is a primary extended being or a mathematical body, which contains nothing but three dimensions and is the universal locus of all things. Matter is a secondary extended being, or that which has, in addition to extension or mathematical body, also a physical body, that is, resistance, antitypy, solidity, the property of filling space, and impenetrability, which consists in its being constrained either to give way to another being of this kind which strikes it or to stop it. Motion therefore comes from this quality of impenetrability. So matter is a being which is in space or coextensive with space. Motion is change of space. But figure, magnitude, situation, number, etc., are not entities really distinct from space, matter, and motion but are merely properties brought about within space, matter, motion, and their parts by a supervening mind. I define figure as the limit of the extended; magnitude, as the number of parts in the extended. I define number as one and one and one, etc., or as unities. Situation reduces to figure, for it is a configuration of a plurality. Time is nothing but magnitude of motion. Since all magnitude is a number of parts, why should it be surprising that Aristotle defined time as the number of motion?

Heretofore these terms have merely been explained, however, and the sense in which we are using them interpreted; nothing has been proved. Let us now show that we need no other things to explain the phenomena of the world and to determine their possible causes—indeed, that there cannot be other things. However, if we show that no other things are necessary besides mind, matter, space, and motion, this will itself make it clear that the hypotheses of those recent thinkers, who use only these to explain phenomena, are the better ones. For it is a defect in hypotheses to assume what is unnecessary. A reading of recent philosophers does in fact show sufficiently that everything in the world can be explained in these terms alone, and my exposition, above, of the possibility of reconciling Aristotle with them is thereby confirmed. It must also be noted that those hypotheses are better which are clearer. The human mind can in fact imagine nothing other than mind (when it thinks of itself), space, matter, motion, and the things which result from the relations of these terms to each other. Whatever more you add to them is only words which can be spoken and variously combined but not explained or understood. Who can imagine a being which partakes neither of extension nor of thought? So what need is there to assume incorporeal souls in beasts and plants, substantial forms for the metallic elements, without extension and thought?[62] Campanella in his book *De sensu rerum et magia* and Marcus Marci on operative ideas were wrong but consistent with their own hypotheses, and therefore more correct, in ascribing sense, knowledge, imagination, and will to the substantial forms of inanimate things. The occult philosophy of Agrippa is not unlike this; he assigns an angel to everything as its obstetrician, so to speak. Scaliger's discussion of the plastic power and its wisdom is also similar. Thus we return to as many little gods as there are substantial forms—to a heathen polytheism. In fact, all those who speak of these incorporeal substances of bodies cannot explain what they mean without a translation into terms of mind.[63] Hence they ascribe to them appetite, or[64] a natural instinct from which natural knowledge arises. The result is such axioms as these: nature does nothing in vain; everything avoids its own destruction; nature strives for continuity; like enjoys like; matter desires a nobler form; and others of this kind, though there is in fact no wisdom in nature and no appetite; yet a beautiful order arises in it because it is the timepiece of God. From these considerations it is clear that the hypotheses of the reformed philosophy are superior to those of the Scholastics, in that they are not superfluous but on the contrary clear.

It remains to prove, by more subtle reasoning, that in explaining the nature of bodies we cannot assume any other entities than those which I have named. This is done as follows. Everyone calls that a body which is endowed with some sensible quality. Many of these sensible qualities can be removed from the body in such a way that it remains a body nevertheless. For even if a body lacks color, odor, taste, it is still called a body. You will admit that air, for example, is a body, although it is transparent and frequently lacks color, taste, and odor. Similarly, the air is a body even when it lacks sound. Therefore those qualities that can be seen, heard, tasted, and smelled may be rejected as not at all constituting the nature of a body. The problem is thus reduced to the tactile qualities. In fact, such primary qualities as heat, humidity, dryness, and cold can be absent individually; heat can be absent from water, humidity from earth, dryness from air, and cold from fire, yet each of these may be a body. That the other tactual qualities, for example, smoothness, lightness, tensity, etc., do not constitute the nature of a body is generally admitted, and appears from the very fact that they are called secondary and therefore arise from others which are constitutive, and also because there is not one of them which cannot be absent from a body. It remains therefore to seek some sensible quality which occurs in all bodies and only in bodies and by which men may distinguish body from nonbody, as if by a criterion. Beyond any doubt this is mass or antitypy, together with extension. For whatever men sense as extended, they do not at once call it a body, for they sometimes consider it a mere appearance or phantasm—though it is in fact always a body and has antitypy, even when this quality may appear to our intellect only, not to our senses. But they do call a body what they not only see but also touch, that is, what they discover has antitypy, and they deny this name to whatever lacks antitypy. Whether learned or ignorant, therefore, men find that the nature of body consists in two things—extension and antitypy together. The former we derive from sight, the latter from touch, and by the combination of both senses we usually ascertain that things are not phantasms. To be extended, however, is nothing else but to be in space, and antitypy is the impossibility of being in the same space with another thing, but one or the other having to move or be at rest. The nature of body therefore evidently is constituted by extension and antitypy, since there is nothing in things without a cause, and nothing ought to be supposed in bodies whose cause cannot be discovered in their first or constitutive principles. But this cause cannot appear unless these principles are well defined. Therefore we can assume nothing in bodies which does not follow from the definition of extension and antitypy. But from these concepts are derived only magnitude, figure, situation, number, mobility, etc. Motion itself is not derived from them. Hence there is no motion, strictly speaking, as a real entity in bodies. I have demonstrated, instead, that whatever moves is continuously created and that bodies are something at any instant in assignable motion, but that they are nothing at any time midway between the instants in motion—a view that has never been heard of until now but which is clearly necessary and will silence the atheists. Hence it is clear that the explanation of all qualities and changes must be found in magnitude, figure, motion, etc., and that heat, color, etc., are merely subtle motions and figures.

As for the rest, I venture to assert that atheists, Socinians, naturalists, and skeptics can never be opposed successfully unless this philosophy is established. I believe this philosophy is a gift of God to this old world, to serve as the only plank, as it were, which pious and prudent men may use to escape the shipwreck of atheism which now threatens us.[65] Though my acquaintance with learned men has been very slight and recent, I shudder when I think how many I have met who are at once brilliant thinkers and atheists. An unpublished book by Bodin is being circulated from hand to hand (and, like Naudé, I wish that it would never be published); a most effective work, which he calls "the secret of sublime things"[66] and in which he is the professed enemy of the Christian religion. The dialogues of Vanini are child's play compared to it. I have read it carefully, and I thank God with all my heart for instructing me in these philosophical defenses, by which I was able easily to turn back his shafts. I should be ungrateful, however, if I denied my debt to you for many of them. The efforts which the enlightened Spizel is once more exerting to eradicate atheism must be praised. I believe you have seen his letter about this argument, which was published at this book fair. Listen to an experience which I had in connection with him. In a period of leisure, but working in the confusion of an inn, I once wrote about two sheets in which I tried to demonstrate, more accurately than usual, the immortality of the soul and the existence of God. I sent these sheets to a friend who passed them on to the reverend Mr. Spener, a pastor in Frankfurt, with their authorship properly concealed. Spener sent them to Spizel, and Spizel recently attached them to the end of his letter to Anton Reiser on the eradication of atheism, with the title Confession of Nature against Atheists.[67] I do not disapprove, but I regret that the sketch was printed most incorrectly; the sorites particularly, in which I tried to prove the immortality of the soul, was thrown into great confusion by changing the beginnings of the lines. Spizel admitted that he did not know who the author was. I should appreciate a judgment about the reasoning in the demonstration. I do not seek praise but criticism, since it is in the interest of religion not to be defended perfunctorily. Meanwhile I have already penetrated much more deeply, I think, into both problems, for you will not read there what I have found out since about the perpetual creation involved in motion, and about the innermost nature of a thinking being or a mind.[68] . . .

For the rest, distinguished Sir, I have discussed this whole matter with you at greater length, because I have no more learned and equitable judge of these things. Since you have thrown light into all the corners of ancient learning, and do not spurn the discoveries of the moderns when they are worthy, you alone of all men can best explain them and examine this. For you are right in holding that, although new opinions may be offered and their truth most convincingly shown, we ought almost never to depart from the generally accepted terms. If the Scholastics had done this, we would not be in difficulty now. Farewell, ornament of our land, and may you not only complete your lucidly developed theories but publish them. For many of them are both conceived and carried through with rare felicity of mind.

4

Letter to Thomas Hobbes

July, 1670

Hobbes's early influence on Leibniz is conspicuous, though Couturat has adequately refuted Tönnies' effort to trace his logical method back to the English thinker (Cout. L., pp. 457-73). Leibniz was much impressed by both the *De corpore* and the *De cive* but sought to supplement them, the former with an *Elementa de mente*, the latter with a theological argument for justice as the will of the most powerful, namely, God.

Leibniz's youthful and flattering attempt to begin an exchange of letters failed, both at this time and later when he tried again in Paris. The letter presents his opinions about Hobbes in exaggerated form but is of interest also for his physical views at a period between that of the letter to Thomasius (No. 3) and the *Theory of Abstract Motion* of 1671.

* * *

[G., VII, 572-74][69]

Mainz, July 13/22, 1670

Most esteemed Sir,

To my great delight I recently learned from the letters of a friend visiting in England that you are still alive and in full health at so great an age. Hence I could not refrain from writing. If my doing so is inopportune, you can punish it by silence; for me it will still suffice to have given witness of my feeling. I believe I have read almost all your works, in part separately and in part in the collected edition, and I freely admit that I have profited from them as much as from few others in our century. I am not given to flattery, but everyone who has had the privilege of following your writings on the theory of the state will acknowledge, as I do, that nothing can be added in such brevity to its admirable clearness. There is nothing more polished and better adapted to the public good than your definitions. Among the theorems which you deduce from them there are many which will remain established. There are some who have abused them, but I believe that in most cases this occurred because the right principles of application were ignored. If one were to apply the general principles of motion—such, for example, as that nothing begins to move unless it is moved by another body, that a body at rest, however large, can be impelled by the slightest motion of a moving body, however small, and others—if one were to apply these by an ill-timed leap to sensible things, he would be derided by the common man unless he had demonstrated in advance, and to minds prepared for it, that for the most part bodies which seem to be at rest are insensibly in motion. Similarly, if one were to apply what you have demonstrated about the state and republic to all groups which are commonly called by that name, and what you attribute to the supreme power to all who claim for themselves the name of king, prince, monarch, or majesty, and your views about complete freedom in the state of nature to all cases in which citizens of different states transact certain affairs among themselves; then, if I am not mistaken, he too would be very much in error about your opinion. For you acknowledge that there are many communities on earth which are not one state but a confederation of many and that there are many titular monarchs to whom others have never transferred their will. Nor will you deny that, assuming a ruler of the world, there can be no purely natural state of man which would place him beyond the pale of any community, since God is the common monarch of all; and that certain men are therefore wrong in ascribing license and impiety to your hypotheses.

As I have said, I have always understood your works in this way, and I acknowledge that I have received great light from them in carrying out a work on rational jurisprudence on which I am collaborating with a friend. For I observed the unbelievable subtlety and soundness of expression with which the Roman jurisconsults gathered their answers which are preserved in the Pandects—qualities in which your own writings strongly resemble theirs. I realized that a large part of them were arrived at almost entirely by demonstration from the law of nature alone and that the rest were deduced with the same degree of certainty from a few principles which were arbitrary, it is true, but drawn from the practice of the Republic. When I first set my feet in the paths of jurisprudence, therefore, I began four years ago to work out a plan for compiling in the fewest words possible the elements of the law contained in the Roman Corpus (in the manner of the old Perpetual Edict), so that one could, so to speak, finally demonstrate from them its universal laws. There are many laws which will prove refractory to this method, especially in the Imperial Rescripts, because they do not belong to natural law. However, these are clearly discernible among the rest and will be counterbalanced by the multitude of the others—especially since I venture to assert that half of the Roman law is mere natural law. And it is well known that almost all of Europe uses this law wherever it has not been distinctly invalidated by local custom.

But I must confess that I sometimes vary these long and tedious concerns with other more pleasant ones, for I also have the habit of sometimes meditating upon the nature of things, though this is like being carried into a foreign world. I have been thinking about the abstract principles of motion, where the foundations which you have laid seem to me remarkably justified. I agree absolutely with you that one body is not moved by another unless the latter touches it and is in motion and that, once begun, every motion continues unless impeded by something. Yet I confess that there are certain matters about which I have hesitated, especially about this: I have not found that you account clearly for the cause of consistency, or, what is the same thing, of cohesion in things. For if, as you seem somewhere to suggest, reaction is the sole cause of cohesion, there will be a reaction even without an impact, since reaction is motion in opposition to a pushing body, but the impact does not produce the opposition to itself.[70] But reaction is a motion of the parts of a body from its center outward to its circumference. This motion is either unimpeded or impeded. If unimpeded, the parts of the body will move outward and so depart from the body to which they belong, which is contrary to experience. If impeded, the motion of reaction will stop unless it is revived by external help of a kind which you do not generally find here. I do not mention that it can hardly be explained what cause it is that moves any single body to strive [*conor*] from center to circumference in every sensible point, or how the reaction of the body struck can alone be the cause of the impetus of the rebound increasing with the impetus of the striking body—while it would be consistent with reason for a greater impetus of incidence to diminish the reaction. But perhaps these small doubts of mind have arisen because I do not sufficiently understand your views. I should think that the conatus of the parts toward each other, or the motion through which they press upon each other, would itself suffice to explain the cohesion of bodies. For bodies which press upon each other are in a conatus to penetrate each other. The conatus is the beginning; the penetration is the union.[71] But when bodies begin to unite, their limits or surfaces are one. Bodies whose surfaces are one, or τὰ ἔσχατα ἕν,[72] are according to Aristotle's definition not only contiguous but continuous, and truly one body, movable in one motion. You will recognize that, if there is any truth in these thoughts, they will change many things in the theory of motion. It remains for me to show that bodies which press upon each other are in a conatus to penetrate. To press is to strive into the place hitherto occupied by another body. Conatus is the beginning of motion, and therefore the beginning of existence in the place into which the body is striving. To exist in a place in which something else exists is to have penetrated it. Therefore pressure is the conatus of penetration. But there can hardly be anyone more accurate in examining demonstrations than are you, distinguished Sir, and you will judge these matters more exactly.[73] . . .

For the rest, I wish that we might hope for a kind of collection of your thoughts from the publication of your works up to the present time, especially since I have no doubt that you have reasoned out the principles involved in so many of the new experiments which you and doubtless many other men of genius have produced in recent years—principles which it would be in the interest of mankind not to lose. I wish also that you had expressed yourself more distinctly about the nature of mind. For though you have rightly defined sensation as a permanent reaction, as I said a little earlier, there is no truly permanent reaction in the nature of mere corporeal things. It only appears so to the senses but is in truth discontinuous and is always stimulated by a new external cause. So I fear that, when everything is considered, we must say that in beasts there is no true sensation, but only an apparent one, any more than there is pain in boiling water; and that true sensation such as we experience in ourselves cannot be explained by the motion of bodies alone—especially since you never demonstrate, so far as I know, the proposition which you use so often, to the effect that every mover is a body.[74]

But I am burdening you too long with my trifles! I shall stop now, since my witness has been given. And I shall always profess, both among friends and, God willing, also publicly (since I am myself a writer), that I know no one who has philosophized more exactly, clearly, and elegantly than you, not even excepting that man of divine genius, Descartes himself. I wish that you, my friend, who of all mortals could best do it, had taken into consideration what Descartes attempted rather than accomplished—that you had ministered to the happiness of mankind by confirming the hope of immortality. May God preserve you still a very long time to achieve this task.

5

Theological Writings Related to the CATHOLIC DEMONSTRATIONS

1668-70

Leibniz's concern with theology was greatly stimulated by the Roman Catholic pietism of the court at Mainz. In this early period his chief theological interests were to prove the existence of God, to justify his ways with men, to establish the proofs of immortality, and to demonstrate the essential agreement of Catholic and Protestant doctrines of the Eucharist. Both law and physics were held to support theology, law driving its ultimate base from the divine harmony, and the nature of bodies, their cohesion and motion, providing an infallible demonstration of the existence of immaterial order and power.

The project of a definitive apology for Christianity, to be called the Demonstrationes Catholicae, arose out of discussions with Baron Boineburg in 1669 or 1670 and was later revived at Hanover in 1679.[75] As planned in 1669, this work was to consist of a series of philosophical prolegomena and four parts. The prolegomena were to include logic, metaphysics, physics, and practical philosophy. The parts were to deal, in order, with the demonstration for the existence of God, the demonstration of immortality, the proof of the Christian mysteries, and a demonstration of the authority of the church and scripture. Leibniz's turn to Platonism at this time is reflected in his summary of the proposed chapter li of Part III, which also refutes the common charge that his concern with religion was purely political in motive: "The beatific vision or intuition of God face to face is the contemplation of the universal harmony of things, because God or universal mind is none other than the harmony of things or the principle of beauty within them."[76]

The occasion for writing the first of the three following selections is given in the letter to Thomasius (No. 3). The proof of the existence of God may be compared with that in No. 1, I. The other two selections are probably preliminary studies intended for Parts II and III of the Catholic Demonstrations, respectively, included here for their bearing on Leibniz's psychology and his doctrine of ideas.

* * *

I

THE CONFESSION OF NATURE AGAINST ATHEISTS

1669

[G., IV, 105-10]

Part I. That Corporeal Phenomena Cannot Be Explained without an Incorporeal Principle, That Is God

Francis Bacon of Verulam, a man of divine genius, has rightly said that casually sampled philosophy leads away from God but that, drunk more deeply, it leads back to him.[77] This is confirmed in our own century, which is fruitful alike of science and of impiety. For through the admirable improvement of mathematics and the approaches which chemistry and anatomy have opened into the nature of things, it has become apparent that mechanical explanations —reasons from the figure and motion of bodies, as it were—can be given for most of the things which the ancients referred only to the Creator or to some kind (I know not what) of incorporeal forms. The result was that truly capable men for the first time began to try to save or to explain natural phenomena, or those which appear in bodies, without assuming God or taking him into their reasoning. Then, after their attempt had met with some little success, though before they arrived at foundations and principles, they proclaimed, as if rejoicing prematurely at their security, that they could find neither God nor the immortality of the soul by natural reason, but that in these matters faith must rest either on civil laws or on historical records. This was the judgment of the most acute Mr. Hobbes, whose great discoveries should earn for him our silence on this matter if his authority had not explicitly affected this view for the worse. Unfortunately there are others who have gone even further and who now doubt the authority of the sacred scriptures and the truth of history and the historical record, thus bringing an unconcealed atheism into the world.

It seemed to me unworthy for our mind to be blinded in this matter by its own light, that is, by philosophy. I began therefore myself to undertake an investigation, and all the more vigorously as I became more impatient at being dispossessed, by the subtleties of these innovators, of my life's greatest good, the certainty of an eternity after death and the hope that divine benevolence would sometime be made manifest toward the good and the innocent.

Setting aside all prejudices, therefore, and suspending the credit of scripture and history, I set my mind to the anatomy of bodies, to see whether the sensory appearance of bodies can be explained without assuming an incorporeal cause.

At the beginning I readily admitted that we must agree with those contemporary philosophers who have revived Democritus and Epicurus and whom Robert Boyle aptly calls corpuscular philosophers, such as Galileo, Bacon, Gassendi, Descartes, Hobbes, and Digby, that, in explaining corporeal phenomena, we must not unnecessarily resort to God or to any other incorporeal thing, form, or quality

(Nec Deus intersit, nisi dignus vindice nodus inciderit),[78]

but that, so far as can be done, everything should be derived from the nature of body and its primary qualities—magnitude, figure, and motion.

But what if I should demonstrate that the origin of these very primary qualities themselves cannot be found in the essence of body? Then indeed, I hope, these naturalists will admit that body is not self-sufficient and cannot subsist without an incorporeal principle. I will prove this without obscurity or detours.

For if these qualities cannot be derived from the definition of a body, they obviously cannot exist in bodies left to themselves. Every reason for an affection must be derived either from the thing itself or from something extrinsic to it. But a body is defined as that which exists in space. All men call what they find in some space a body, and, conversely, they find what they call a body in space.[79] This definition consists of two terms, "space" and "to exist in."

On the term "space" are based the magnitude and figure of a body, for a body has the same magnitude and figure as the space which it fills. But there remains a doubt as to why it fills this much space and this particular space rather than another; for example, why it should be three feet long rather than two, or why square rather than round. This cannot be explained by the nature of bodies themselves, since the same matter is indeterminate as to any definite figure, whether square or round. Therefore only two replies are possible. Either the body in question must be assumed to have been square from all eternity, or it has been made square by the impact of another body—if, that is, you refuse to resort to an incorporeal cause. If you say it has been square from all eternity, you give no reason for it, for why should it not have been spherical from all eternity? Eternity cannot be considered the cause of anything. But, if you say that it was made square by the motion of another body, there remains the question of why it should have had any determinate figure before such motion acted upon it. And if you refer the reason for this, in turn, to the motion of another body as cause, and so to infinity, each of your replies will again be followed by a question through all infinity, and it will become apparent that this basis for asking about the reason for each reason will never be removed, so that no full reason for the figure will ever be given. Therefore it appears that the reason for a certain figure and magnitude in bodies can never be found in the nature of these bodies themselves.

We said that the definition of a body has two terms—"space" and "existence-in"—and that, though the term "space" involves some magnitude and figure, it does not involve a determinate magnitude and figure. Motion pertains to existence-in-this-space, for when a body begins to exist in a different space than it did before, this very fact implies that it is moved. Considering the matter more accurately, however, it becomes clear that mobility arises from the nature of a body but that motion itself does not. Since the body is in this space, it can also be in another space equal and similar to the first, that is, it can be moved. For to be able to be in another space than at first is to be able to change space, and to be able to change space is to be movable. For motion is change of space. Actual motion, however, does not arise from existence-in-space; this involves rather the contrary when a body is left to itself, namely, permanence in the same space, or rest. Therefore no reason for motion can be found in bodies left to themselves. Hence it is futile to try to escape as do those who give the following reason for motion: that every body either moves from all eternity or is moved by another body which is contiguous to it and in motion. For if they say this body moves from eternity, there is no clear reason why it should not rather have rested from all eternity, since time, even if infinite, cannot be thought of as a cause of motion. But if they say that this body is being moved by another body contiguous to it and in motion, and this again by another, and so without end, they still have given no reason for the first, and second, and third, or anyone whatever being moved, as long as no reason is given for the consequents being moved, which does not also apply to all the antecedents being moved. For the reason for a conclusion is not fully given as long as no reason is given for the premise, especially since the same doubt remains in this case without end.

Thus it has been sufficiently demonstrated, I think, that there can be no determinate figure and magnitude, or any motion whatever, in bodies left to themselves. Because it is a matter for further investigation, I shall remain silent here on the question of whether anyone has heretofore derived the firmness of bodies from their nature itself.

By the firmness of bodies we mean (1) that a large body does not give way to a small one which pushes it; (2) that bodies or their parts cohere with each other, this being the basis for those tactile qualities commonly called secondary, namely, solidity and fluidity, hardness and softness, smoothness and roughness, tenacity and fragility, friability, ductility, malleability, and fusibility; and (3) that a hard body is reflected when it strikes another which does not give way. In brief, three properties constitute firmness: resistance, cohesion, and reflection. I shall be glad to call anyone a great philosopher who can explain these by means of the figure, magnitude, and motion of bodies. There appears to be only one way—to assume that a body resists another which strikes it, and rebounds from the blow, because its surface parts are insensibly moved in the collision. But let us assume that the striking body approaches the other, not along the line in which the parts of the body are to meet the blow, but in another, perhaps oblique to it; then according to this view all reaction, resistance, and reflection will cease at once, which is contrary to experience. But cohesion clearly cannot be explained through reaction and motion. If I push part of a paper, the part which is pushed gives way; therefore no reaction or motion of resistance can be assumed. But not only does it give way; it also carries with it the remaining parts which adhere to it. It is indeed truly and with good reason that Democritus, Leucippus, Epicurus, and Lucretius of old, and their modern followers, Peter Gassendi and John Chrysostum Magnenus, asserted that the whole cause of cohesion in bodies may be explained naturally through the interweaving of certain shapes such as hooks, crooks, rings, projections, and, in short, all the curves and twists of hard bodies inserted into each other. But these interlocking instruments themselves must be hard and tenacious in order to do their work of holding together the parts of bodies. Whence this tenacity? Must we assume hooks on hooks to infinity? Yet whatever reason there is for questioning this in the first case will exist also in the second and third, and so without end. There remains only one answer which these most subtle philosophers can make to such objections; they may assume certain indivisible corpuscles, which they call atoms, as the ultimate elements of bodies, which, by their varied shapes, variously combined, bring about the various qualities of sensible bodies. But no reason for cohesion and indivisibility appears within these ultimate corpuscles.

The ancients offered one, but it was so inept that their recent followers are ashamed of it, namely, that the parts of atoms cohere because no vacuum comes between them. From this it would follow that all bodies, once they touch each other, ought to cohere inseparably in the manner of atoms, since there can be no intervening vacuum when any two bodies touch. Nothing is more absurd than such perpetual cohesion or more foreign to experience. In explaining the atoms, we may therefore rightly resort to God, who endows with firmness these ultimate elements of things. I marvel that neither Gassendi nor any other of these most acute philosophers of our century has noticed this excellent opportunity to demonstrate the divine existence. For through the ultimate analysis of bodies, it becomes clear that nature cannot dispense with the help of God.

But since we have demonstrated that bodies cannot have a determinate figure, quantity, or motion, without assuming an incorporeal being, it readily becomes apparent that this incorporeal being is one for all, because of the harmony of things among themselves, especially since bodies are moved not individually by this incorporeal being but by each other. But no reason can be given why this incorporeal being chooses one magnitude, figure, and motion rather than another, unless he is intelligent and wise with regard to the beauty of things and powerful with regard to their obedience to his command. Therefore such an incorporeal being will be a mind ruling the whole world, that is, God.

Part II. The Immortality of the Human Mind, Demonstrated in a Continuous Sorites

The human mind is a being, one of whose actions is thinking.

If one of the actions of a being is thinking, one of its actions is immediately perceptible, without supposing parts in it.

For thought is (1) a thing that is immediately perceptible, mind being immediate to itself when it perceives itself thinking. (2) Thought is a perceptible thing without awareness of parts. This is clear from experience. For thought is that "something, I know not what" which we perceive when we perceive what we think. But when, for example, we perceive that we have thought of Titius, we not only perceive that we have the image of Titius in our mind, for this has parts, of course; such an image is not enough for thinking.

For we have images in the mind even when we do not think of them, but we perceive, besides, that we have been aware of this image of Titius, and in this awareness of our images itself we find no parts.[80]

Assume a being performing a certain action which is immediately perceptible, without a perception of its parts. Then this certain action is a thing without parts;

For a quality immediately perceived in a thing actually belongs to it, since:

The cause of error is the medium, for if an object of perception were the cause of error, it would always be perceived falsely; if the subject were the cause, it would always perceive falsely.

If something has for one of its constituents a thing without parts, then one of its actions must be other than motion;

For all motion has parts, by Aristotle's demonstration and common agreement.

A being whose action is not motion is not a body;

For all bodily action is motion, since every action of a thing is a variation of its its essence, and the essence of a body is being in space.

But motion is a variation of existence in space.

Therefore every action of a body is motion.

Whatever is not a body is not in space; for to be in space is the definition of a body.

Whatever is not in space is not movable, for motion is change of space.

Whatever is immovable is indissoluble, for dissolution is the motion of a part.

Everything indissoluble is incorruptible, for corruption is internal dissolution.

Everything incorruptible is immortal, for death is corruption of the living, or dissolution of its fabric, through which self-moving things obviously move themselves.

Therefore the human mind is immortal. Q.E.D.

II

A Fragment on Dreams[81]

[K., pp. 154-56]

The power of persuasion consists sometimes in giving reasons, sometimes in moving the affections, and sometimes, at the heart of both of these as it were in the art of attracting attention. This consists in certain distinct rules. For we do not carry out most of the things which we know, because we do not pay attention between our actions. But attention is nothing but reflection.

Sleep differs from waking in that when we are awake everything is directed, at least implicitly, toward an ultimate goal. But in dreaming there is no relation to the whole of things. Hence to wake up is nothing but to recollect [recolligere] one's self, to think as follows: Dic cur hic? Sich besinnen.[82] To begin to connect your present state with the rest of your life or with you yourself. Hence we have this criterion for distinguishing the experience of dreaming from that of being awake—we are certain of being awake only when we remember why we have come to our present position and condition and see the fitting connection of the things which are appearing to us, to each other, and to those that preceded. In dreams we do not grasp this connection when it is present, nor are we surprised when it is absent. It is to be noted, however, that now and then the dreamer himself observes that he is dreaming, yet the dream continues. Here he must be thought of as if he were awake for a brief interval of time, and then, once more oppressed by sleep, returned to his previous state. It is also to be noted that some men can wake themselves up, and it is a familiar experience of mine that, when some pleasing vision presents itself, I notice that I am dreaming and try my eyes and pull them open with my fingers to admit the light. We should also think about the cause of sensations of falling out of bed, which are popularly ascribed to lapses into sin, and which occur sometimes, and to some people, almost between the limits of sleep and waking, so that they are suddenly awakened at the very moment of falling asleep. Sometimes when this has happened to me, I can scarcely persuade myself to fall asleep all night. For in the first moment of falling asleep, I suddenly recollect myself and, sensing this fact, leap up. Nor ought we to overlook the spontaneous ejection of semen without any contact in sleep; in wakers it is expelled only when they are strongly agitated, but in sleep the spirits are moved internally by a strong imagination alone and without any rubbing of the members. I have also heard this confirmed by a physician.

Hobbes says that everything appears as present in sleep and that therefore there is no judgment or wonder, but only the occurrence of appearances, as of things observed by the eyes when they are awake and not closed. But, you say, surely we often experience judgment or reflection in dreams, or at least a knowledge of the past which involves judgment, for we both deliberate and remember. But I reply that in dreams we do not do this anew, about the appearances as they are presented, but that a judgment presents itself in a dream only if it is a judgment about the presented appearance which comes from an earlier thought and now recurs as a whole, even though we do not know that it contains the earlier thought. For entire conversations occur to us which are certainly not without judgment, and even dialogues and arguments, not because we are now making judgments about them, but because judgments already made recur with the experiences themselves.

There is one very remarkable thing in dreams, for which I believe no one can give a reason. It is the formation of visions by a spontaneous organization carried out in a moment—a formation more elegant than any which we can attain by much thought while awake. To the sleeper there often occur visions of great buildings which he has never seen, while it would be difficult for me, while awake, to form an idea of even the smallest house different from those I have seen, without a great amount of thought. I wish I could remember what marvelous discourses, what books and letters, what poems beautiful beyond all doubt, but never previously read, I have read in dreams without my shaping them at all, just as if they had just been composed and offered to my sight. This is known:

Hac sunt in fossa
Bedae *Venerabilis* ossa.[83]

The dream of a poetic monk substituted this word for the unfitting word *presbyter*. Noteworthy, too, is what Colomesius tells in his lesser works about a song which Gaulminus dreamed about the immortality of the soul. I do not believe that there is a mortal man who would not confess to me that there have often occurred to him while he dreamed, spontaneously and as if made in a moment, elegant visions and skilfully fashioned songs, verses, books, melodies, houses, gardens, depending upon his interests—visions which he could not have formed without effort while awake. Even such unnatural things as flying men and innumerable other monstrosities can be pictured more skilfully than a waking person can do, except with much thought. They are sought by the waker; they offer themselves to the sleeper. There must therefore necessarily be some architectural and harmonious principle, I know not what, in our mind, which, when freed from separating ideas by judgment, turns to compounding them.[84] A reason must be given why we do not remember waking experiences in a dream but do remember the dream when awake.

III

ON TRANSSUBSTANTIATION

1668(?)

[PA., VI, i, 508-12]

With the help of God, we have undertaken to show the possibility of the transsubstantiation of bread and wine into the body of Christ who suffered for us, which the Catholic church teaches occurs at the time of consecration. It is to be demonstrated, accordingly, that:

1. Bread and wine, losing their own substance, acquire the substance of Christ's body;
2. and become everywhere numerically identical with it,
3. only their appearance or accidents remaining;
4. the substance of Christ's body being present in all places where the appearance of consecrated bread and wine exists.

This proof depends on the interpretation of the terms "substance," "appearances" or "accidents," and "numerical identity," which we develop on the basis of their meanings as accepted by the Scholastics, but which we explain clearly.

(I)

1. Substance is being which subsists in itself.

2. Being which subsists in itself is that which has a principle of action within itself. Taken as an individual, being which subsists in itself, or substance (either one), is a suppositum. In fact, the

Scholastics customarily define a suppositum as a substantial individual. Now actions pertain to supposita.[85] Thus a suppositum has within itself a principle of action, or it acts. Therefore a being which subsists in itself has a principle of action within it. Q.E.D.

3. If that which has a principle of action within itself is a body, it has a principle of motion within itself. Every action of a body is in fact motion, because every action is a variation of essence. So every action of a body is a variation of the essence of body. But the essence or definition of a body is being in space. Accordingly a variation in the essence of body is a variation of existence in space. But variation of existence in space is motion. Thus every action of a body is motion. Q.E.D. . . .

4. No body has a principle of motion within itself apart from a concurrent mind. This has been demonstrated in Part I of the Catholic Demonstrations, where the existence of God is proved.

5. Therefore no body is to be taken as substance, apart from a concurrent mind.

6. Whatever is not substance is accident or appearance.

7. Hence body is accident or appearance apart from a concurrent mind.

8. Something is substance when taken together with a concurrent mind; something taken apart from concurrent mind is accident. Substance is union with mind. Thus the substance of the human body is union with the human mind, and the substance of bodies which lack reason is union with the universal mind, or God. The idea is the union of God with creature.[86]

9. Thus the substance of body is union with a sustaining mind.

10. That whose substance is in its union with a concurring mind is transsubstantiated when its union with the concurring mind is changed.

12.[87] Hence bread and wine as bodies, when the concurrent mind is changed, are substantiated into the body of Christ, or taken up by Christ (inasmuch as the special concourse of the mind of Christ which takes on the bread and wine, in addition to its body, is substituted for the general concourse of the universal or divine mind with all bodies). Q.E.D.

(II)

13. If a body consecrated and appropriated by the mind of Christ has the same concurrent mind as the glorious body of Christ who suffered for us,

14. it has numerically the same substantial form or the same substance as the body of Christ who suffered for us, by No. 9.

15. Accordingly the bread and wine in transsubstantiation are the numerically identical substance as the body of Christ who suffered for us. Q.E.D.

(III)

16. A body which is thus transsubstantiated is changed in no way except in the substantial form or idea of the concurring mind, by No. 9.

17. That in which nothing is changed except the concurrent mind can retain all its qualities or accidents or, if you prefer, species. For mind is compatible with all accidents which do not receive or lose essence through it, but only action.

18. Therefore all accidents or species are preserved in the transsubstantiated bread and wine; extension, firmness, color, odor, etc., can remain. Q.E.D.

(IV)

19. All mind lacks extension. See the Catholic Demonstrations, Part II.

20. Whatever lacks extension is not coextensive with space.[88]

21. Whatever is not coextensive with space is not in a place by itself.

22. Mind is therefore not in a place by itself.

23. Mind acts upon a body which is in space.

24. To this degree, therefore, it can be said to be in space by operation. St. Thomas.[89]

25. Every action of a mind is thought.

26. Mind can think many things together.

27. Therefore mind can by its action be in many places at once.

28. Therefore the mind of Christ can impart operation, action, or subsistence both to the glorious body of Christ and to the species of consecrated bread and wine, at the same time, and in varying cases in various places on the earth.

29. Hence the mind of Christ can be present everywhere in the species of consecrated bread and wine.

30. The mind of Christ, concurring in his glorious body which suffered for us, is his substance, by No. 9.

31. Therefore the substance of the glorious body of Christ can be present everywhere in the species of bread and wine. Q.E.D.

These theorems of ours differ very little from the accepted philosophy. In Aristotle, nature is the principle of motion and of rest. But substantial form is properly nature in the same philosopher. Hence Averroes, Angelus Mercenarius, and Jacob Zarabella also assert that substantial form is the principle of individuation. Those who locate the nature of subsistence in the union of matter and form, like Murcia, agree with this as well.[90] . . .

Our Scholastics will be embarrassed, I believe, not by the contents of this but by the words. I seem to hear them speaking as follows: "What? You who presume to demonstrate the possibility of transsubstantiation, do you expect to satisfy the Church with terms chosen at your own pleasure? After all, you must use the terms 'substance,' 'transsubstantiation,' 'accident,' 'species,' and 'identity' in that sense which the Council of Trent is believed to have favored, and there is no doubt that this council favors that which the chorus of Scholastics has observed. Unless you adhere to this, you deserve the sentence of the Church; you show the mind of a heretic."

Right, O Scholastics! But your warning is too late, since I have already done what you require. For neither my conception of identity, nor that of transsubstantiation, nor of accident or species is an innovation. This from the preceding demonstration. For I demonstrate the numerical identity of substance from the numerical identity of substantial form, in conformity with the principles of the noblest Scholastic and Aristotelian philosophers, those for whom substantial form is the principle of individuation.[91] I define transsubstantiation as change of substantial form. I call appearance whatever can be thought of in a real body deprived of substantial form, that is, matter taken with its accidents. I call substance an entity subsisting in itself. An entity which subsists in itself is the same as what the mass of Scholastics mean by suppositum. For a suppositum is a substantial individual—as, for instance, a person is a rational substantial individual—or a certain substance in particular. Moreover, the School has generally established it as a property of suppositum that it is itself denominated by action; hence the rule that actions belong to supposita. It is clear from this that the suppositum, substance, or entity which subsists in itself—which are all the same thing—is defined correctly in the Scholastic sense also, as that which has a principle of action within itself, for otherwise it would not act but be an instrument of some agent. From this it follows further that substantial form is itself a principle of action;[92] in bodies, of motion. To make the consistency appear even greater, the same interpretation of substantial form follows from another principle of Aristotle and the Scholastics. For Aristotle himself, and the noblest of his followers, agree that substantial form is nature. Nature is the principle of rest and motion. Therefore, even in Aristotle's sense, substantial form is the principle of rest and motion.

A different objection will perhaps be made, which is not to be despised, namely, that it follows from this hypothesis that there is one substantial form for all bodies, the concurrent divine mind. But this does not follow. For, although the divine mind is the same, the concurrent divine mind is not.[93] For the divine mind consists of the ideas of all things.[94] Therefore, since the idea of thing A is one thing, the idea of *B* another, the result is that one idea of the divine mind concurs with *A*, another with *B*. That the composition of ideas does not constitute parts of the divine mind is elsewhere demonstrated with the example of a point. The idea of Plato is therefore the same as the substantial form of Aristotle. From this it is apparent that there is not one substantial form for all bodies but a different one for different bodies, for, as the disposition of nature is varied, the form and idea are also varied; the motion and rest of a body derive from this fact.

It must be shown from the hypothesis of those who hold matter to be mass [*moles*] that they do not require it to be a substance, since those who consider matter to be something insensible do require it to be a substance. It is to be demonstrated from the agreement of philosophers that the substance of a thing does not appear to sense. The word "mind" must therefore necessarily mean something different from that today usurped by sense; otherwise it would appear to sense.[95] The substance of each thing is not so much mind as it is an idea of a concurrent mind. In God there are infinite, really diverse, substances, yet God is indivisible. The ideas of God are the substances, but not the essences, of things. The idea of God is not the substance of things which are moved by mind.

An idea there is contained ideally both passive and active potentiality, both active and passive intellect. Insofar as the passive intellect concurs, there is matter in the idea; insofar as the active intellect, there is form. N.B. Bread and wine are not transessentiated but transsubstantiated. Somewhere in the breviary it is said that the body of Christ is made bread and wine, but this is metonymy. The language of the Council of Trent must be adhered to rigorously; bread and wine are not substance but substantiated being. It is less than correct to say that man is a substance; this is foreign to the use and nature of the word and a modification of the abstract into the concrete. Therefore it cannot be allowed except by metonymy. . . .

Supplement: NOTES ON THE EUCHARIST
1668

[PA., VI, i, 513]

This demonstration has a threefold use—to confirm those who think rightly, to attract the rest, and to prove philosophy a useful and necessary beginning for theology.

The substance of things is an idea. Idea is the union of God and creatures, so that the action of agent and patient is one. A point is at once common to two lines or intersectors. Most apt of all, an angle is at once center and lines.

N.B. There are no ideas in God except as there are things outside of him. Thus a point is not a center except of lines. Now if the substance of things is an idea, and it is asked whether this is everywhere, I reply that it is not everywhere, any more than a creature is elsewhere than in the creator, and that the act of God is in the creature, though God is everywhere. Neither is an angle in all of its sides, although it may be a center of all its sides. It is in this way that the substance of things is in things or appearances. But how God can bring it about that his idea should be in still other places than the appearances, or that it should be a substance in other appearances (for idea or pattern is opposed to examples or instances)—this is a question that deserves accurate thought.

The ideas of God and the substances of things are the same in fact, different in relation; they are, moreover, as action and passion. However, since the substances of things are the act of God on species, we must think of how it can come about that his act upon one species is numerically the same as his act upon another.

But the substance of the body of Christ is its union with Christ, for the substance of everything is its union with mind. Now it is asked how it is possible that the mind of Christ acts in another body than that upon which it ordinarily acts. I reply that God can bring it about that one mind shall be in two bodies when he thinks the same mind or when he thinks of acting immediately upon two bodies. For whatever God can think, that he can also do—at least if he wishes and holds it for the best. . . .

6

Preface to an Edition of Nizolius

1670

(Selections)

Leibniz was induced by Boineburg to prepare an edition of a work published in 1553 by the Italian humanist, Marius Nizolius, and entitled On the True Principles of Philosophy, against Pseudo-Philosophers.[96] For this edition he wrote an introduction which he called "A Preliminary Dissertation on Editing the Works of Others, on the Scope of the Work, on Philosophical Diction, and on Nizolius' Errors," but to which he also referred, on the title-page, as "On the Philosophical Style of Nizolius."

Written in Leibniz's most erudite style, this preface is stuffed with historical and bibliographical allusions, most of which are here omitted. Its permanent interest lies in his discussion of language, particularly philosophical language, his theory of the relation of logic to rhetoric and metaphysics, his theory of induction, and his evaluation of Scholasticism and nominalism.

* * *

[G., IV, 138-76]

. . . In general, there seem to me to be three praiseworthy marks of speech—clarity, truth, and elegance. Utility is a property rather of things themselves. That is clear which is well perceived; so speech is clear if the meanings of all its words are known, at least to the attentive. An utterance is true whose meaning is perceived through a right disposition of both the percipient and the medium; for clarity is measured by the understanding, truth by sense. This is the unique and truest definition of truth, from which all the canons of right judgment can be derived, whatever may have been said heretofore. But this must be explained elsewhere; here we will merely make it clear with an example. The sentence, "Rome is situated on the Tiber," is true for the reason that nothing more is needed to understand what it says than that the sentient being and the medium be in a right relation. The sentient should certainly not be blind or deaf, and the medium or interval should not be too large. If this be granted, and I be in Rome or near it, it will follow that I shall at one glance see the city and the river and realize that this city is situated on this river, and I shall hear the city called Rome and the river called the Tiber. Something similar is true in abstract matters; the sentence, "The binary number is even," is true because if I see (or hear, touch, think of) a binary number, I see one and one (by the definition of the binary number, perceived through hearing or reading) and nothing more. Hence I see two parts in the pair, one and one, equal to each other and making up the whole, since one equals one. But a number whose two parts make up the whole and are equal is called even (by the definition of even, perceived through reading or hearing). Therefore, whoever perceives that a given number is binary perceives that it is even and therefore that the given sentence is true.

Speech is elegant if it is pleasant to hear or read. But, since our discussion concerns philosophical discourse and the style which befits it, we shall omit elegance for the present, although we may admit that it can be of great service in securing attention, in moving minds, and in impressing things more deeply on the memory.

Only that degree of certainty is to be had which a given matter admits.[97] But, even when defined most rigorously, certainty is nothing but the clearness of truth, so that it follows from the very notion of certainty that the qualities of philosophical discourse, that is, of speech seeking certainty, are clarity and truth. Indeed, the truth of a proposition obviously cannot be known unless the meaning of its words is known, that is, unless it is clear (by the definition of clear speech).

Clearness in speech applies not merely to the words but also to constructions. For if a construction is not clear, one may indeed know what the words mean simply and taken singly but not what they mean in this particular place and related to the others. But in the matter of obscurity of construction, speakers and poets are more apt to sin than are our philosophers. Therefore we shall speak of the clarity of words taken by themselves. . . . The clarity of a word arises from two factors—either from the word in itself or from its context in speech. The clarity of a word in itself, again, has two sources—origin and usage. The origin of a word, finally, can be resolved into two factors—the use of the root and the analogy of the derivation made from the root. Usage is the meaning of a word known in common by all who use the same language. Analogy is a meaning reached by shifting, or by derivation, which is likewise known to all who use the same language. For example, the usage or meaning of the word fate is the necessity of events. In origin it is compounded from the usage of the root and from analogy. The root is for or fari, the meaning of the root is "to say" (dicere); the analogy of fate is fatum, the perfect passive participle of the designated verb in Latin, so that the origin of fate and dictum is the same. Mostly, too, usage has arisen from origin by a certain figure of speech. This appears in the given example, since fatum is originally the same as dictum but means in usage what will happen necessarily. Let us see, therefore, whose dictum will happen necessarily; it is manifest that God's commands alone fit this description. Thus by origin fate is dictum, then by antonomasia or par excellence, the dictum of God, then by synecdoche the dictum of God concerning the future, or the decree of God, and finally by the metonymy of cause, what will happen necessarily, which is the present usage of the word. Thus the good grammarian, and the philosopher as well, must deduce the usage of a word from its origin by a continuous sorites of figures of speech, so to speak. I consider Julius Caesar Scaliger the great master in this work. His books on origins are now lost, to the great detriment of philosophy, except as his son has perhaps used them in his notes on Varro, but these differ for the most part from what his father had already published and scattered through his own writings. So, although we have greater erudition in the thought of the son, we have lost the greater acumen and philosophy in the book of origins of the father.[98]

This rule must be adhered to in applying words—if the origin disagrees with the usage, we should follow the usage in speech rather than the origin; but if the usage is either doubtful or does not forbid it, we should rather cling to the origin. If the word has multiple usages, one must either be careful to abstract some so-called formal meaning, that is, the meaning which includes all usages in it, . . . or if this cannot be done, one must at least establish some one usage which may be called original, i.e., from which the others follow in the same way in which it itself follows from the origin, namely, through a series of figures of speech. . . . In either case, whether selecting the more original usage or the formal meaning, one must make sure above all else to choose among the many usages offered that one which is nearest the origin of the word. Once chosen, however, the meaning must be reduced, if there is place, to a definition and submitted to the reader or listener. For a definition is nothing but the expressed meaning of a word or, more briefly, the meaning signified. In a definition care must be taken not only that the definition be reciprocally true but also that it be clear. Technical terms are therefore to be shunned as worse than dog or snake, and one must abstain particularly from those words for categories which are far removed from Latin usage. Once set up, the definition is to be adhered to consistently, so that, wherever you substitute the definition for the term defined, there results no absurd statement. Even if no definition is given beforehand, the use of a word should be uniform so that the same definition could be substituted anywhere. Thus, for any given word, we should see what meaning is attached to it and, conversely, what word should be attached to a given meaning. In this, both brevity and clarity must be respected. The greatest clarity is found in commonplace terms with their popular usage retained. There is always a certain obscurity in technical terms.

. . . An analogy should be both generally accepted and fitting, so that the definition of the new word which we intend can be molded from the meaning of the root and the analogy. For example, haecceitas does not have a usual analogy; hoccitas (or hoccimonia) would be better, like quidditas, not quaedeitas. The definition of hoccitas can be formed from its root and the analogy, for the root is hoc and the analogy itas. Moreover, this analogy or reason for the derivation refers to the reason for the root word or to that quality of the root due to which it is what it is said to be. Thus hoccitas will be the reason why something is called hoc (just as Aristotle defines quality as that by which we are said to be quales) or the quality of this insofar as it is this. Nor is it surprising that we define abstract matters in terms of concrete, since the concrete is more familiar. . . .

. . . Technical terms are to be avoided, as I have said; indeed, they are to be used with care whenever possible. But this is not always possible because of the prolixity which would result if popular terms were always used. For example, a square is quadrilateral, equilateral, and rectangular, but the words "equilateral," "quadrilateral," and "rectangular" (not to mention "plane") are technical in their turn. Hence they can be further resolved. That is quadrilateral which has only four sides. A side is a bounding line. That is rectangular all of whose angles are right. An angle is the intersection of lines; right is that which is equal on both sides. Thus if we are to avoid technical terms, we shall have to put all these words in place of the word square: that figure, all of whose bounding lines are equal and whose bounding lines are only four, and in which all intersections of terminating lines are equal on both sides. If even greater rigor is demanded, the words line, bounding, intersection, and equality must be further resolved, for their popular usage does not exactly fit the concepts of geometry. . . .

I believe that even the blind can see how annoying it would be, and how awkward, to have always to use all these words in place of the word "square" in our demonstrations. To this can be added what I have already said in many passages of the Art of Combinations.

Our judgments are thus rendered more reliable by this process of analyzing technical terms into merely popular ones; hence a perfect demonstration merely carries out such analysis to the ultimate and best-known elements. But if this entire analysis were done in one place—the subject and predicate of each judgment into their definitions, and the ingredient terms of the definitions into further definitions—or if we had constantly to return to other definitions or demonstrations we had already given or to the works of some author who had done this, our memory would be overtaxed. Hence it has been necessary to devise technical terms for those things to which people have not assigned names, either because they have not thought of them (like the quadratic curve) or because they use them rarely (like hyperbolas and parabolas) and believe it sufficient to designate them by circumscription if this is sometimes desirable. There is certainly nothing which cannot be expressed in popular terms, at least by using many of them. Hence Nizolius rightly urges that anything be regarded as nonexistent, fictitious, and useless to which there cannot be assigned a word in the vernacular, however general; that is, as I interpret him, a word which joined together with other general words can express the matter.

For philosophers are not always superior to common men in that they think of different things, but rather in that they think in another way, that is, with the eye of the mind, with reflection and attention, and comparing things with each other. But there is no better way to arouse the attention of men for a certain matter than to assign it a definite word to serve as a memory token for myself, and a sign for others to distinguish it by. So far are philosophers from thinking more hidden and noble thoughts than other men, moreover, that even before the incomparable Lord Bacon of Verulam and other enlightened men recalled philosophy from its airy digressions, or from an imaginary space, back to earth and to the guidance of life, there were certain barbering alchemists who had sounder and clearer insights into the nature of things than did any philosophaster sitting behind closed doors, bent exclusively over his haecceitates or his hoccitates. I do not deny, however, that there are also many men of sound and useful learning among the philosophers, especially among those who draw from the springs of Aristotle and the ancients rather than from the cisterns of the Scholastics.

Therefore philosophers often think just what other men think but with attention to what others have neglected. Joachim Jung of Hamburg, for instance, a true philosopher, has observed, collected, compared, and classified many species of insects which many mortals have undoubtedly seen but overlooked and trampled under foot and has assigned new names to them on the basis of this comparison. We hope that these and other meditations of his will be edited very soon by the enlightened Vogel.[99] But sometimes, I admit, philosophers perceive bodies or bodily qualities which other people never have perceived. Thus the chemists frequently produce new and hitherto unknown bodies by a variety of mixtures and analyses. The same thing happens in the mixtures of medical men, many of which have given their creators, whose names were assigned to them, more lasting fame than if a statue of granite bearing a eulogy had been erected to them. Beyond a doubt, whoever first used the microscope saw many new qualities such as hitherto unknown colors. In these cases either new names must be formed or old ones adapted by some figure of speech based on the relation of the new thing or quality to the old.

We may thus regard it as established that whatever cannot be explained in popular terms is nothing and should be exorcised from philosophy as if by an incantation, unless it can be known by immediate sense experience (like many classes of colors, odors, and tastes). So it is customary for certain capable philosophers to urge the brilliant masters of dialectic and disputation either to explain their terms clearly or, if they want to avoid this vexing task, to step down to some living and popular language and attempt to explain their meaning in it. When this happens, it is remarkable either how they become confused or, if they attempt the change, how they are ridiculed by all men of judgment and experience who are present and who are not interested exclusively in the Latin language. This, I am convinced, is the reason why the exaggerated Scholastic style of philosophizing has gradually become obsolete in England and France, for people there have long since begun to cultivate philosophy in their own tongue, so that in a measure the common people, and even women, have become able to judge about such matters. The same thing would undoubtedly happen in Italy and Spain if the Scholastic theologians had not come to the aid of their philosophical cousins there. In Germany the Scholastic philosophy is more firmly established because, among other reasons, a late start was made in philosophizing in German, and even now we have hardly made an adequate beginning. But I venture to say that no European language is better suited than German for this testing and examination of philosophical doctrines by a living tongue. For German is very rich and complete in real-terms, to the envy of all other languages. No people have for centuries more diligently cultivated the practical arts, among them especially the mechanical arts, so that even the Turks use German names for metals in the mines of Greece and Asia Minor. On the other hand, the German language is easily the poorest for expressing fictions, certainly far less fitted for this than French, Italian, and other languages derived from Latin. For in the daughter-languages of Latin, a term of barbarous Latinity can easily be converted into good French or Italian through a slight twist. Hence many terms of Scholastic philosophy have been retained in some way in French translation. But no one has attempted such a thing in German without being hissed by everybody. Whoever wishes to retain or to twist Latin terms into German will not be philosophizing in German but in Latin.[100] And to no avail; he would not be understood by anyone ignorant of Latin, for, unlike Italian and French, German is worlds removed from the Latin. The reason why philosophy has only more recently been dealt with here in the vernacular is that the German language is incompatible, not with philosophy, but with a barbarous philosophy. And since this barbarous way of philosophizing has only lately been rejected it is not surprising that our language has been slow to come into philosophical use. . . .

. . . Since we have established the fact that there is nothing which cannot be explained in popular terms and that, the more popular the terms, the clearer is the discourse, . . . it is obvious that the norm and measure for selecting terms should be the most compendious popularity or the most popular compendiousness. Hence wherever equally compendious popular terms are available technical terms are to be avoided. This is indeed one of the fundamental rules of philosophical style, though violated frequently, especially by metaphysicians and dialecticians. For dialectical and metaphysical subjects occur commonly in the utterances, writings, and thoughts of uneducated people and are met with frequently in everyday life. Spurred on by this frequent demand, the people have as a result designated these subjects by special words that are familiar, very natural, and economical. When such words are available, it is a sin to obscure matters by inventing new and mostly more inconvenient terms (to say nothing of the awkwardness often shown in manufacturing such words), and to make one's self admired only by the ignorant but ridiculous to others. The same thing holds true in morals, politics, and law. Since these fields are all alike open to the understanding of all, we can rarely hope for anything but obscurity to result from inventing new terms in them. I say rarely, for I admit that there is no science in which technical terms are not needed, especially when the common people either do not understand the matter or dismiss it from their attention. It is in mathematics, physics, and mechanics that new terms or terms with new applications are most necessary, for the matters dealt with in these sciences are not directly obvious to the understanding or in frequent common use. . . .

. . . One further warning seems worth while here, since its opposite is commonly held; in philosophizing accurately, only concrete terms should be used. For the most part Aristotle himself seems to me to have done this; he uses ποσὸν, ποιὸν, τὰ πρός τι rather than ποσότης, ποιότης, σχέσις, or, if it were proper to speak this way, προσ-τινότης. But his adherents generally change this, as if it were too awkward, and fancy themselves as more subtle, with God's help, when they use abstract terms exclusively. Yet it appears certain that this passion for devising abstract words has almost obfuscated philosophy for us entirely; we can well enough dispense completely with this procedure in our philosophizing. For concretes are really things; abstractions are not things but modes of things. But modes are usually nothing but the relations of a thing to the understanding, or phenomenal capacities. Indeed, modes can be repeated to infinity, so that there are qualities of qualities and numbers of numbers. If all these were things, not only infinity but contradiction would result. For if being-ness [entitas] were a being [ens], if real-ness were real, if somethingness [aliquiditas] were something, everything would be its own form, a part of the concept implied in itself. If therefore anyone wants to give a perfect exposition of the elements of philosophy, he must abstain from abstract terms almost entirely. I do recall that the astute Hobbes ascribes some usefulness to abstract terms, by the very convincing argument that it is one thing, for example, to double some warm water, another to double its warmth. But this duplication of heat can itself be expressed in concrete terms, for if I say that the same thing has been made twice as hot, or that the effect by which the heat is measured is doubled, everyone will understand that it was not the hot water but the heat that was doubled. So I must confess that I have never found any great use for abstract terms in rigorous philosophizing but rather many and great abuses and very dangerous ones. . . .

. . . So far we have shown that technical terms are to be avoided as far as possible. Now we must note that, whether terms are popular or technical, they ought to involve either no figures of speech or few and apt ones. Of this, the Scholastics have taken little notice, for, strange though this sounds, their speech abounds with figures. What else are such terms as to depend, to inhere, to emanate, and to inflow? On the invention of this last word Suárez prides himself not a little. The Scholastics before him had been exerting themselves to find a general concept of cause, but fitting words had not occurred to them. Suárez was not cleverer than they, but bolder, and introducing ingeniously the word influx, he defined cause as what flows being into something else, a most barbarous and obscure expression.[101] Even the construction is inept, since influere is transformed from an intransitive into a transitive verb; and this influx is metaphorical and more obscure than what it defines. I should think it an easier task to define the term "cause" than this term influx, used in such an unnatural sense.

. . . Only truth remains to be discussed, but it is the logician's proper task to teach the rules as to how truth is to be achieved and confirmed and all the devices for invention and judgment. For the logician, in turn, the otherwise necessary burden of examining and painstakingly discussing all his terms is wonderfully lightened if they are accurately clear. For if no word is used unless its meaning is clearly and accurately defined, all equivocation is necessarily banished, and with this a vast throng of fallacies will at once disappear. Hardly anything more will then be required for sound judgment than that the senses be protected against error by means of the right constitution of the sense organs and the medium, and the intellect by observing the rules for ratiocination. Under these circumstances, I almost believe that, just as there are two parts of rhetoric, one concerned with combining words elegantly, ornately, and effectively, the other with stirring the emotions, so there are also two parts of logic, the one verbal, the other real; one dealing with the clear, distinct, and proper use of words or with philosophical style, the other with the guidance and control of thinking. . . . Therefore Nizolius is not wrong in his frequent insistence that precise formulation be used in logical disquisition, nor, perhaps, are we in this preface, in which we have expanded, beyond Nizolius, this principle which is necessary in every part of an encyclopedia. For our special purpose in preparing this edition is to contribute something, even through the work of another author, to the establishment of that sounder philosophy which the concerted efforts of the greatest geniuses are now advancing so excellently everywhere. We therefore hope that the reading of Nizolius' treatise will result in rich fruitage in philosophical matters, by leading men more and more to use this sober, proper, natural, and truly philosophical way of speaking.

. . . The errors of Nizolius are many and great. . . . Certainly the masterpiece is his imputing the errors of the Scholastics to Aristotle and his heaping loud reproaches upon men more prudent than himself, John Pico, Leonicenus, Rudolph Agricola, and Vives, whom he accuses of adulation because they tried to defend Aristotle. But after so many efforts have been made by the most learned scholars in interpreting Aristotle and overcoming the misunderstandings of uncultured people, nothing is better known in our own century than that Aristotle is free and innocent of all this ineptness with which the Scholastics are so often polluted. . . . He who consults the interpreters whom I have just mentioned[102] will readily admit, I believe, that Aristotle is far different than he is commonly described and that we must not, as did Valla, Nizolius, Basso, and other Aristotelianizers, read back into the author of the text what we find to be due either to the inexperience of his interpreters, or to their being put at disadvantage because of the times in which they lived. . . .

I do not hesitate to say that the older Scholastics are far superior to certain of our contemporaries in acumen, soundness, prudence, and even in their more cautious avoidance of useless questions. For some of our contemporaries, who can hardly add anything worth printing to the ancients, do only one thing; they accumulate references, invent countless absurd questions, divide one argument into many, change methods, and contrive new terms again and again. This is how they produce so many and such bulky books.

How greatly inferior the insights of the Scholastics of this and the preceding centuries are to the earlier ones can be shown by the nominalist sect, the most profound of all the Scholastics, and the most consistent with the spirit of our modern philosophy. This sect, once very prosperous, is not extinct, certainly among the Scholastics. This seems to indicate that there has been a decrease rather than an increase in penetration. But since Nizolius did not hesitate openly to call himself a nominalist, near the end of Book I, chapter vi, and since the nerve of his argument consists in his destruction of the reality of forms and universals, I consider it worth while to present certain facts about the sect. Nominalists are those who believe that all things except individual substances are mere names; they therefore deny the reality of abstract terms and universals forthright. The first nominalist, it is believed, was a certain Roscelin of Brittany, who aroused bloody conflicts in the academy of Paris. . . . The sect had long been eclipsed, however, when the Englishman William of Occam, a man of the greatest genius and learning for his age, first a disciple but soon the greatest opponent of Duns Scotus, unexpectedly revived it. Gregory of Rimini, Gabriel Biel, and many of the Augustinian order agreed with him, and Martin Luther's earlier writings also show clearly a love of nominalism, until, in the course of time, the monks all began equally to be affected by it. The general rule which the nominalists frequently use is that entities must not be multiplied beyond necessity. This rule is frequently opposed by others as violating the divine opulence, which is generous rather than parsimonious and takes pleasure in the variety and abundance of things. But those who raise this objection have not, I think, grasped the meaning of the nominalists, which, though more obscurely stated, reduces to this:

the simpler a hypothesis is, the better it is. And in accounting for the causes of phenomena, that hypothesis is the most successful which makes the fewest gratuitous assumptions. Whoever acts differently by this very fact accuses nature, or rather God, its author, of an unfitting superfluity.

The hypothesis of any astronomer who can explain the celestial phenomena with few presuppositions, namely, with simple motions only, is certainly to be preferred to that of one who needs many orbs variously intertwined to explain the heavens. From this principle the nominalists have deduced the rule that everything in the world can be explained without any reference to universals and real forms. Nothing is truer than this opinion, and nothing is more worthy of a philosopher of our own time. So much so that, I believe, Occam himself was not more nominalistic than is Thomas Hobbes now, though I confess that Hobbes seems to me to be a super-nominalist. For not content, like the nominalists, to reduce universals to names, he says that the truth of things itself consists in names and, what is more, that it depends on the human will, because truth allegedly depends on the definitions of terms, and definitions depend on the human will. This is the opinion of a man recognized as among the most profound of our century, and, as I said, nothing can be more nominalistic than it. Yet it cannot stand. In arithmetic, and in other disciplines as well, truths remain the same even if notations are changed, and it does not matter whether a decimal or a duodecimal number system is used.

The same thing is true of all the reformers of philosophy today; if they are not super-nominalists, they are almost all nominalists. Hence Nizolius is all the more appropriate for our times. . . .

. . . Finally, a serious error of Nizolius concerning the nature of universals must not go unnoticed, for if the reader is not careful enough, it will lead him far astray from the course of true philosophy. He tries to convince us that a universal is nothing more than all singulars taken simultaneously and collectively and that when I say, "Every man is an animal," the meaning is that all men are animals. This is indeed true, but it does not follow that universals are collective wholes. Nizolius proves it in this way: Every whole is either continuous or discrete. A universal is a whole that is not continuous and is therefore discrete. But a discrete whole is collective, and the concept of *the genus man* is not different from that of *a herd*. So the meaning of this proposition, *every man (or the whole genus man) is rational*, is the same as this, *all the sheep which graze here are white*, or *the whole flock is white*. But you are mistaken, Nizolius. The discrete whole contains another genus besides the collective, namely, the distributive. For when we say: *every man is an animal*, or *all men are animals*, the acceptation is distributive; if you take that man (Titius) or this man (Caius), you will discover him to be an animal, or a sentient being. If, as Nizolius holds, every man, or all men, is a collective whole, and the same as the whole genus man, an absurd expression will result. For if they are the same, we may substitute the whole genus man in the proposition that all men are animals or every man is an animal, and we have the following very inept proposition: the whole genus man is an animal. The same holds true for a flock, for if the universal abstracted from all the sheep which graze here were, as Nizolius holds, identical with the collective whole of them, this proposition would be true: the whole herd is a sheep. Let us examine still another example, which leaves less room for some desperate evasion. The old jurisconsults, who spoke Latin accurately, as Nizolius will not deny, affirm that if someone makes a bequest like this, the genus is legacy: *I give and bequeath my horse to Titius*. But in the sense of Nizolius, since the genus is the whole abstracted from the singulars, it would be the same if he had said, "I give and bequeath all my horses to Titius." A rare sample of jurisprudence, indeed! But by substituting the distributive whole for the collective, on the contrary, the case becomes clear, for the sense will be, *I give and bequeath this or that horse to Titius*. Let us add this point: if in the proposition, *every man is an animal*, the genus is affirmed of the species, and if the genus is a universal, and the universal is the whole genus abstracted from the individuals: then if we substitute all animals taken together for the word "animal," this proposition will result: *man is all animals taken together*, while it suffices to say that man is some animal, or any one of the universal genus of animals. This error of Nizolius is, in truth, no small one, for it conceals an important consequence. If universals were nothing but collections of individuals, it would follow that we could attain no knowledge through demonstration—a conclusion which Nizolius actually draws—but only through collecting individuals or by induction. But on this basis knowledge would straightway be made impossible, and the skeptics would be victorious. For perfectly universal propositions can never be established on this basis, because you are never certain, in induction, that all individuals have been considered. You must always stop at the proposition that all the cases which I have experienced are so. But since, then, no true universality is possible, it will always remain possible that countless other cases which you have not examined are different. But, you may ask, do we not say universally that fire—that is, a certain luminous, fluid, subtle body, usually flares up and burns when wood is kindled, even if no one has examined all such fires, because we have found it to be so in those cases we have examined? That is, we infer from them, and believe with moral certainty, that all fires of this kind burn and will burn you if you put your hand to them. But this moral certainty is not based on induction alone and cannot be wrested from it by main force but only by the addition or support of the following universal propositions, which do not depend on induction but on a universal idea or definition of terms: (1) *if the cause is the same or similar in all cases, the effect will be the same or similar in all*; (2) *the existence of a thing which is not sensed is not assumed*; and, finally, (3) *whatever is not assumed, is to be disregarded in practice until it is proved*. From these principles arises the practical or moral certainty of the proposition that all such fire burns. . . . Hence it is clear that induction in itself produces nothing, not even any moral certainty, without the help of propositions depending not on induction but on universal reason. For if these helping propositions, too, were derived from induction, they would need new helping propositions, and so on to infinity, and moral certainty would never be attained. Perfect certainty can clearly never be hoped for from induction, even with the addition of any aids whatever. By induction alone we should never perfectly know the proposition that the whole is greater than its part. For someone would soon appear and for some reason deny that it is true in cases not yet observed. We know this from the fact that Gregory of St. Vincent denied that the whole is greater than its part, at least of angles of contact, and that others have denied that it is true of infinity. Thomas Hobbes (or someone) began to doubt the geometric proposition which was proved by Pythagoras and regarded as worthy of the sacrifice of a hecatomb. I have read this with some amazement.[103] . . .

7

ELEMENTS OF NATURAL LAW

1670-71

The project in legal reform in which Leibniz was engaged at Mainz with Herman Andrew Lasser took the form of a work on Rational Jurisprudence. Lasser took charge of the last two parts, concerned with the actual reform of the law; Leibniz undertook the first two—the Elements of Natural Law and the Elements of Contemporary Civil Law.

The first principles of law and justice are for Leibniz essentially the same as those of his theology, since God is, after all, the supremely powerful lawgiver and the source of all harmony. But the ethical consequences of these metaphysical principles are made clear in law rather than in theology.

This long discussion of the elements of natural law,[104] written not before 1670, relates the project of legal reform to the cultural state of Europe and explains Leibniz's principles as they apply to law, ethics, and aesthetics. It is the most complete of many studies in natural law from this period.

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[PA., VI, i, 459-65]

It is obvious that the happiness of mankind consists in two things—to have the power, as far as is permitted, to do what it wills and to know what, from the nature of things, ought to be willed. Of these, mankind has almost achieved the former; as to the latter, it has failed in that it is particularly impotent with respect to itself. For the power of man has certainly increased immensely in the present age, and, of the two elements of our earth, one is almost tamed and the other restored from the rapacity of the former. We have spanned the seas by a kind of mobile bridge and so united lands that were once divided by enormous gaps. The heavens themselves cannot defeat us, and, when they hide their stars, we find help in an ugly piece of glass. And having moved them nearer to us and multiplied our eyes to be admitted into the interior of things and to enlarge the face of the world a hundredfold, we then suddenly have disclosed to us new worlds and new species, both equally admirable—the one in magnitude, the other in smallness.

Nor do we lack glasses [conspicilia] of another kind, by which to survey the scattered bits not merely of space but of time. The light of history has been brought to us, so that we seem to have lived always. A new kind of monument has been prepared—though of paper, yet more enduring even than bronze—by which great geniuses may survive all the injuries of barbarous and tyrannical times and always anticipate the assured immortality of heaven by an imaginary eternity of fame. We have thus embraced time in our writings, the heavens in our telescopes, the earth in travel, and the sea in ships. The other elements follow this example. The air too now reveals its secrets which have been hidden from all eternity. Fire has already conspired, by the inexplicable goodness of God, to serve as a kind of commendable torture wherever other things persist in denying his powers and has given us those thunderbolts which no force can equal except when human madness opposes them to each other.[105]

Now that we are conquerors of the world, there assuredly remains an enemy within us; everything is clear to man but man, the body to the mind, and the mind to itself. To drop the tragic style and speak more naturally, we are ignorant of the medicine of bodies and of minds. We treat the former as does an agent something for the sake of gain; we treat the latter as a boy does his lesson—as nothing, for he learns it in the hope of forgetting it. It is not surprising, therefore, that until now we have established no science of the pleasant, or the useful, or the just. The science of the pleasant is medicine, that of the useful is politics, and that of the just is ethics.

The physician should explore our structure, the position and motion of our parts, the causes of pleasures, so that he may conserve and produce them, and of our pains, on the other hand, so that he may remove and prevent them. To this end he should make use of such aids as characteristics, optics, music, perfumes, cooking, as well as chemistry and botany. We possess an unbelievable mass of unusual observations, but they are crude, undigested, and without use except almost by chance. To what end has this material been gathered and made ready with so much study, if we are to postpone until another century the construction of our happiness? Why not strike a blow with combined forces against this persistence of nature in concealing herself? Why, I ask, unless it is because the blame for the imperfection of natural science must fall back upon the public, since they could improve it if everyone wished it, and if individuals wished that all should wish it in general? All will not do together, however, what individuals will and can do, unless the matter is attacked in the right way, and on the basis of the secrets of true politics, by those to whom it is given to make a great part of mankind happy as an example to the rest and to make themselves happy through this part. For those who appraise this matter truly understand that the sciences of the just and the useful, that is, of the public good and of their own private good, are mutually tied up in each other and that no one can easily be happy in the midst of miserable people.

Until now we have therefore been ignorant of, that is we have not imbibed, we have not drunk from, the true springs of equity and of good. We can indeed be ignorant of what we have read, heard, and even thought a thousand times, if reflection, so to speak, and the attention of the mind have been absent. For what we know that we know, we also will to use. But what we do not know that we know, we do not know at all.

There are two things which make us take notice—eloquence and demonstration. The former moves the affections and brings the blood to boil, so to speak. The latter creates a clear comprehension in the mind. Hence the former vanishes unless it takes on demonstrative form and is only the senseless ecstasy of a mob agitated by frantic emotions. The latter affects but few indeed, and only great men, but those great men in whom alone there is hope for improvement in this greatest of centuries, in which a kind of consuming hunger brings all great talents to the solid nourishment of truth. If we were to satisfy these, if we were to urge them to do their own thinking, if we were to establish truth on a firm ground, then we might be able to lessen the flow of eloquence.

Of the entire utility of this I have written elsewhere, I hope not too popularly. Now it will suffice to sow the seeds of that science which shows how individuals should give way to the good of all if they wish happiness to revert to themselves, increased as by a rebound. The answer to this problem has been intrusted to the *Elements of Law and Equity*,[106] which we shall now undertake to develop with the good will of Heaven.

1. The doctrine of Right belongs to those sciences which depend on definitions and not on experience and on demonstrations of reason and not of sense; they are problems of law, so to speak, and not of fact. For since justice consists in a kind of congruity and proportionality, we can understand that something is just even if there is no one who practices it or upon whom it is practiced. Just so the relations of numbers are true even if there were no one to count and nothing to be counted, and we can predict that a house will be beautiful, a machine efficient, or a commonwealth happy, if it comes into being, even if it should never do so. We need not wonder, therefore, that the principles of these sciences possess eternal truth. For they are all *conditionalia*, conditional truths, and treat not of what does exist but of what follows if existence be assumed. They are not derived from sense but from a clear and distinct intuition [*imaginatio*], which Plato called an idea, and which,

when expressed in words, is the same as a definition.[107] That which can be understood clearly, however, is not always true, though it is always possible; and it is also true, in addition, whenever the only question is that of possibility. But, whenever there is a question of necessity, there is also one of possibility, for if we call something necessary, we deny the possibility of its opposite. It therefore suffices to demonstrate the necessary connections between things and their consequences in this way: by deducing them from a clear and distinct intuition (that is, from a definition when this intuition is expressed in words), through a continuous series of definitions which imply them; that is, through a demonstration. Therefore since the doctrine of Law is a science, and the basis of science is demonstration, and definition is the principle of demonstration, it follows that we must first of all investigate the definitions of the words Right, just, and justice, that is, the clear ideas by which we usually estimate the truth of propositions or of the right use of words in speech, even when we do not know we are doing so.[108]

2. The method of our investigation is to gather the more important and distinctive examples of the use of these terms and to set up some meaning consistent with these and other examples. For just as we construct a hypothesis by induction from observations, so we construct a definition by comparing propositions; in both cases we make a compendium of all other instances, as yet untried, out of the most important given cases. This method is necessary whenever it is not desirable to determine the use of terms arbitrarily for one's self. For as long as we are speaking only to ourselves or to our special group, or about something not generally known, it is in our power to assign to any definite idea whatever the word which will serve to arouse our memory, so that it will be unnecessary for us always to repeat the definition, that is to say, ten other words. But when we are writing for the public and on a commonly discussed matter in which we do not lack terms, it is either the folly of one who does not want to be understood, or the

malice of a deceiver, or the pride of one who seeks to bring others to his own views without offering any reasons, to think up words or usages private and peculiar to one's self. This is a matter which I have discussed at length in the preface to Nizolius.

3. From the beginning, however, both our own good and that of others are involved in the question of right. For, as concerns our own good, it is universally admitted that what one does out of the necessity of protecting his own security seems to be done justly. In the next place, no one is willing to separate justice from prudence, for, as everyone agrees, justice is a definite virtue, but every virtue restrains the affections so that nothing can obstruct the dictates of right reason. But the right reason for our actions is the same as prudence. It follows, therefore, that there can be no justice without prudence. Prudence, furthermore, cannot be separated from our own good, and any statement which contradicts this is empty and foreign to the actual practice of those who utter it, whatever they may say against it. There is no one who deliberately does anything except for the sake of his own good, for we seek the good also of those whom we love for the sake of the pleasure which we ourselves get from their happiness. To love is to find pleasure in the happiness of another. We love God himself above all things because the pleasure which we experience in contemplating the most beautiful being of all is greater than any conceivable joy. It follows from this, if you consider the matter completely, that no one can be obligated to do evil to himself. What is more, no one can be obligated except for his own good. For since justice is something of which a prudent man can be convinced, and since no one can be convinced of anything except for reasons of his own utility, it follows that every duty must be useful. We therefore derive two propositions from the common agreement of those who use these terms: first, that everything necessary is just and, second, that every duty (or injustice) is useful (or harmful). It remains to see to what extent there is in justice a basis for considering the good of others.

4. In the first place, however, all men proclaim that an injury

has been done and, indeed, that nature has been violated if anyone seeks to harm others without gaining any advantage for himself, or if he refuses to do something useful to others which involves no harm to himself, or if he chooses to let a person die whom he could save at no cost to himself; but also if he places some advantage of his own, which does not bear upon the common good, above the misery or happiness of others, if he feasts his cruel eyes on the dead, if he achieves his ends by resorting to murder and torture, if he prefers to let a servant be destroyed rather than his own vice. Furthermore, there is no one who approves making a profit at the expense of others. Finally, there is also another ground for complaint if the same misfortune afflicts two people, but one of them assumes that only he is to be recompensed, for, when the cause is alike in equivalent cases, the right is equal. In all these cases men find not only the deed blameworthy but also the will. Hence these propositions: First, it is unjust to will to harm another except for one's own good. Second, it is unjust to will the cause of another's destruction unnecessarily. Third, it is unjust to will harm to another for one's own gain. Fourth, it is unjust to be unwilling to bear a common injury.

5. Since it is agreed in summary, therefore, that the just consists of having a reason for the good of one's self and of others, let us try to define this step by step.

Whether perhaps the just is to be defined as willing what is harmful to no one? But then it will not be just to seek one's own harm that other harm may be avoided.

Whether then that is just which is done for the sake of avoiding harm to one's self? But then it would be just to prefer one's vice even though a servant perish.

Whether just is what happens by reason of its own necessity? But then it would not be permissible to prefer one's own gain to that of another.

Whether the just is what is publicly approved? But then my security should be postponed by public misfortune.

Whether just is whatever is not a cause of war? But then it would not be just, in case of assault, to prefer that someone else be destroyed rather than myself.

Whether the just is whatever does not deserve censure by a prudent man? Certainly. But the injustice makes the censure; the censure does not make the injustice. This argument is also valid if you define the just as whatever prudent men do not regard as punishable; or as whatever can be defended in the assemblies of wise men in general; or as what is in conformity with the best commonwealth; or as whatever conforms to nature; or whatever pleases a wise and powerful man; or whatever is of advantage to the stronger. Likewise the view that you should be sure to do, yourself, what you demand of others; that you demand nothing of others which you would not do yourself; and that each one should do what, if done by all, is useful to each.

Nor is the just whatever is not contrary to the social good. For even Curtius could justly have refused to make his horrible leap, though the security of his country was involved, if all hope after death had been denied him.[109]

Nor is the just whatever is congruent with a rational nature. For what would such a nature wish for itself? Whether the just is whatever can exist together without deformity? For that would be congruent in the popular sense. But then the sick would be unjust. Whether the just is rather whatever is congruent with right reason? But then every error, even if no harm results to the one who errs, would be a crime.

Whether justice is virtue preserving the mean between two affections of man toward man—love and hate? As a boy I myself supported this opinion enthusiastically, for being fresh from the Peripatetics, I failed thoroughly to digest the fact that all the other virtues governing our affections have themselves one governess—the justice of things. But I put aside this convincing rather than sound view without difficulty when it became clear that the whole basis of virtue is found in the fact that the affections can do nothing but obey and that there can thus be only one moral virtue, as it is called: to be the master of one's own spirits and blood, so to speak; to be able to glow, to rise up, to cool off, to rejoice, and to grieve when we wish and as long and as strongly as we wish. This balancing of contraries, however, usually turns out to be mixed. To this we may add that to be ineptly profuse or unseasonably persist ought not to be ascribed to the breaking-off of an affection, since men reason falsely that a kind of honor comes to them from luxury or prodigality or from promising more than one's capacities or uneasy fortunes justify, or, on the other hand, from being unreasonably diffident about one's abilities and fortunes. So I can be unjust, not because of the hate of him whom I harm, but because my love for myself or for a third person prevails over my love for you. But to love myself and you, or you and a third person, are not affections opposed to each other, although they may accidentally conflict, since both can exist together in the highest degree. Yet, although we may assign this latitude of love and hate to justice, it would be unjust to love another too much to one's own injury. This is inept rather than unjust, however, for whom does it injure save him who does it? But to injure one's self is not, strictly speaking, injustice. The value of such a different use of words would be less than the resulting confusion between just and good, and we should have to form new words, whereas we are trying not to resort to such aids. Therefore the just will not be whatever does not conflict with prudence in aiding and harming others. For it would follow that, where the right to harm someone is once admitted, he is unjust who fails to do this harm in conformity with the strictest rules.

Whether just is really what is not contrary to conscience? But what does it mean to be contrary to conscience, since conscience is the memory of one's own deeds? Whether that deed of ours is unjust whose memory is burdensome, i.e., for which we are sorry? If so, every harm which we inflict upon ourself through our own fault will be unjust. Therefore we do ourselves an injury, contrary to our earlier view. But you say there are certain innate concepts, and there has been placed within us a certain witness of the just and the unjust, stronger than all our protests, which tortures the wicked by the mere consciousness of crime, our nature being so formed by the wonderful wisdom of its creator that, if there were no other punishment, this would certainly be the punishment of sinners, the grief of the perpetrator. But let those consult this oracle who will. They will find that this internal torturer is fear; fear, I say, of punishment by a judge who can be neither deceived nor escaped and whose opinion impressed on even the most simple by the aspect of this universe, not even the most profligate can put aside, however much they may wish. Just, therefore, will be that whose punishment is not to be feared, and this basis for defining it we now judge to have been established.

Where, then, do we stand after so many attempts? Whether justice is the habit of willing the good of others for the sake of our own? This is nearest to the truth, but a little distorted. There is in justice a certain respect for the good of others, and also for our own, but not in the sense that one is the end of the other. Otherwise it may follow that it will be just to abandon some wretched person in his agony, though it is in our power to deliver him from it without very much difficulty, merely because we are sure that there will be no reward for helping him. Yet everybody abominates this as criminal, even those who find no reason for a future life; not to mention the sound sense of all good people which spurns so mercenary a reason for justice. And what shall we say of God; is it not unworthy to hold him an instrument to this? But how reconcile these views to those given above, where we said that we do nothing deliberately except for our own good, since we now deny that we should seek the good of others for the sake of our own? They are to be reconciled, beyond doubt, by a certain principle which few have observed, but from which a great light can be thrown upon true jurisprudence as well as upon theology. The answer certainly depends upon the nature of love.

There is a twofold reason for desiring the good of others; one is for our own good, the other as if for our own good. The former is calculating, the latter loving. The former is the affection of a master for his servant, the latter that of a father for his son; the former that of one in need toward the instrument for meeting his need, the latter that of a friend for his friend; the former for the sake of some other expected good, the latter for its own sake. But, you ask, how is it possible that the good of others should be the same as our own and yet sought for its own sake? For otherwise the good of others can be our own good only as means, not as end. I reply on the contrary that it is also an end, something sought for its own sake, when it is pleasant.

For everything pleasant is sought for its own sake, and whatever is sought for its own sake is pleasant; all other things are sought because of the pleasure they give or conserve or whose contrary they destroy. All people sense this, whatever they may say; or at least they act according to it, whatever they may believe. Ask the Stoics, those airy dreamers, cloud-dwellers, star-gazers, those enemies, professedly of joy, but really of reason. Observe, pry into their acts and movements. You will find that they cannot stir a finger without pointing out the falsehood of their own foolish philosophy. Honor [honestas][110] itself is nothing but pleasure of mind. If you listen more carefully to Cicero when he declaims in favor of honor and against pleasure, you will hear him plead magnificently for the beauty of virtue, the deformity of wickedness, the conscience quiet and at peace with itself in the bosom of the joyous mind, the good of uninjured reputation, the triumph of glory.[111] But what is sought in all these things in themselves, save pleasure? I say in themselves, for there is still another fruit of glory—it increases power. For it makes us loved or feared. We seek beautiful things because they are pleasant, for I define beauty as that, the contemplation of which is pleasant.

Pleasure, however, is doubled by reflection, whenever we contemplate the beauty within ourselves which our conscience makes, not to speak of our virtue. But as a double refraction can occur in vision, once in the lens of the eye and once in the lens of a tube, the latter increasing the vision of the former, so there is a double reflection in thinking. For every mind is something like a mirror, and one mirror is in our mind, another in the mind of someone else. So if there are many mirrors, that is, many minds recognizing our goods, there will be a greater light, the mirrors blending the light not only in the eye but also among each other. The gathered splendor constitutes glory. There is an equal reason for deformity in the mind; otherwise there would be no shadows to be increased by the reflection of the mirrors.[112]

But to return to our path, in the consensus of mankind everything pleasant in itself is sought after in itself, and everything sought after in itself is pleasant. We can therefore readily understand how we not only can achieve the good of others without our own but can even seek it in itself; namely, insofar as the good of others is pleasant to us. A true definition of love can be built from this. For we love him whose good is our delight. Therfore we have confirmed (as I have already said) that everything which is loved is beautiful, that is, delightful to a sentient being, but not that everything beautiful is loved. For we do not really love nonrational beings, since we do not seek their good in itself, except those who make the popular mistake of imagining that there is some reasonable element—I know not what—in animals which they call sense. Since justice, therefore, demands that we seek the good of others in itself, and since to seek the good of others in itself is to love them, it follows that love is of the nature of justice.

Justice will therefore be the habit of loving others (or of seeking the good of others in itself and of taking delight in the good of others), as long as this can be done prudently (or as long as this is not a cause of greater pain). For even the joy which we take in our own good must be curbed by prudence, lest it sometime become the cause of greater pain; how much more then the joy we take in that of others. Yet it may not be pertinent to call in prudence here, for even one who believes, though foolishly, that the good of others is unrelated to his own pain is nonetheless obligated to them. Therefore justice will be the habit of deriving pleasure from an expectation of the good of others, even to the expectation of our own pain. But these last words can be extended even further, for, even though our own pain intervenes, nothing prevents our taking pleasure in an expectation of the good of others, though our act itself may follow the greater pleasure or the lesser pain.

To reach a conclusion at last, the true and perfect definition of justice is therefore the habit of loving others, or of finding joy in the expectation of the good of others whenever an occasion arises. It is equitable to love everyone else whenever an occasion arises. We are obligated (we ought) to do that which is equitable. It is unjust not to be delighted in the good of others when an occasion arises. The just (the permissible) is whatever is not unjust. Therefore the just is not merely what is equitable—to delight in the good of others when the issue arises—but also what is not unjust—to do what you will when no issue is involved. Right is the power of doing what is just.[113]

8

Studies in Physics and the Nature of Body

1671

It is not until the Paris period that Leibniz, under the particular tutelage of Huygens, developed any adequate understanding of the issues in modern mathematics and physics. His first interest in these fields came earlier, however, as a result of philosophical and theological problems, and in "proud ignorance"[114] he not only answered most controversial questions to his own satisfaction but ventured to enter into the jealous public discussions then at their height between English and French scholars. In 1669 he had proposed corrections to the laws of motion worked out by Huygens and Wren. The New Physical Hypothesis, published in 1671, outlined a somewhat incoherent program of new physical and cosmological principles. This work appeared in two parts, one of which, The Theory of Abstract Motion, he dedicated to the French Academy, the other, The Theory of Concrete Motion, to the British Royal Society. The Fundamental Principles presented in the former treatise, though an unassimilated combination of Cavalierian, Hobbesian, Cartesian ideas, suggest a number of his own later metaphysical principles, though the central concept of force is still lacking.

The second selection, written late in 1671, shows Leibniz's skill in constructing empirical definitions and reveals the motives for his phenomenalism. His criticisms of Descartes are already well formulated.

* * *

I

THE THEORY OF ABSTRACT MOTION: FUNDAMENTAL PRINCIPLES

[Praedemonstrabilia][115]

[G., IV, 228-32]

1. There are actually parts in a continuum, though the learned Thomas White believes the contrary.

2. And these are actually infinite, for the indefinite of Descartes is not in the thing but in the thinker.

3. There is no minimum in space or in a body, that is, no part of which the magnitude would be zero; for such a thing cannot have any position, since whatever has a position can be in contact at the same time with several things which do not touch each other and hence will have many faces. Nor can a minimum be assumed without it following that there are as many minima in the whole as in the part, which implies a contradiction.

4. There are indivisibles or unextended beings, for otherwise we could conceive neither the beginning nor the end of motion or body. The proof of this is as follows. There is a beginning and an end to any given space, body, motion, and time. Let that whose beginning is sought be represented by line ab, whose middle point is c, and let the middle point of ac be d, that of ad be e, and so on. Let the beginning be sought at the left end, at a. I say that ac is not the beginning, because cd can be taken from it without destroying the beginning; nor is it ad, because ed can be taken away, and so forth. So nothing is a beginning from which something on the right can be removed. But that from which nothing extended can be removed is unextended. Therefore the beginning of body, space, motion, or time—namely, a point, conatus, or instant—is either nothing, which is absurd, or unextended, which was to be demonstrated.

5. A point is not that which has no part, or whose part need

not be considered, but that which has no extension, or whose parts lack distance, whose size may be neglected, or is unassignable, less than can be expressed in any but an infinite ratio to any other sensible space, less than any which can be given. This is the foundation of the method of Cavalieri,[116] and thereby it is obviously demonstrated what he asserts, namely, that we must think of the rudiments, so to speak, or the beginnings of lines and figures, as smaller than any given magnitude.

6. The ratio of rest to motion is not that of a point to space but that of nothing to one.

7. Motion is continuous or not interrupted by little intervals of rest.

8. For where a thing is once at rest, it will always remain at rest unless a new cause of motion occurs.

9. Conversely, a thing once moved will always move with the same velocity and in the same direction if left to itself.

10. Conatus is to motion as a point to space, or as one to infinity, for it is the beginning and end of motion.[117]

11. Hence whatever moves, no matter how feeble, and no matter how large may be the obstacle it meets, will propagate its conatus in full against all obstructions into infinity, and furthermore it will impress its conatus on all the rest. For though it cannot be denied that a moving body does not proceed in its motion even when it has been stopped, it at least strives to do so, and, what is more, it strives, or, what is the same thing, begins, to move the obstructing bodies, however large, even though they may exceed it.

12. There can therefore be many contrary conatuses in the same body at the same time. For given the line ab, and c moving from a to b, and d, on the other hand, moving from b to a, and colliding with c; then at the moment of collision c will strive against b even though it is thought to stop moving, because the end of motion is conation. But it will also strive in the opposite direction if the opposing body is thought to prevail, for it will begin to move backward. But even if neither should prevail over the other, this

will still be the same, because every conatus is continued through the resisting bodies to infinity, and so, that of each one in the other. And if equal velocities accomplish nothing, neither will a double or any greater velocity, for two times nothing is nothing.

13. One point of a moving body at the time of conatus, or in a time less than any assignable time, is in many places or points of space, i.e., the body will fill a part of space greater than itself, or greater than it would fill at rest or if moving move slowly, or if striving in one direction only. Yet this space is still inassignable or consists in a point, although the ratio of the point of the body (or the point it would fill at rest) to the point of space it fills in motion is like that of an angle of tangential contact to a rectilinear angle or of a point to a line.

14. In general, too, whatever moves is never in one place when it moves, nor indeed in one instant or least moment of time, because whatever moves in time strives, or begins and stops moving, in that instant, that is, it changes its place. It is also irrelevant to say that, when it strives in a time less than any given time, it is in a minimum space, for there is no minimum of time, otherwise there would also be one of space. For whatever moves through a line in a time less than any given time moves through a line in space less than any given line, or a point, and therefore through an absolutely minimum part of space in an absolutely minimum time. But by the third principle, there is no such thing.

15. On the contrary, at the time of impulsion, impact, or collision, the boundaries or points of two bodies either penetrate each other or are in the same point of space. For when one of two colliding bodies strives into the position of the other, it begins to be in it, that is, it begins to penetrate or to be united. For conatus is beginning, penetration, union. The bodies are therefore in the beginning of union, or their boundaries are one.

16. Therefore bodies which push or impel each other are in a state of cohesion, for their boundaries are one, for, as Aristotle too defines them, bodies whose limits are one [ὧν τὰ ἔσχατα ἕν]

are continuous or are in cohesion.[118] For if two things are in one place, one cannot be put in motion without the other.

17. No conation without motion lasts longer than a moment except in minds. For what is conation in a moment is the motion of a body in time. This opens the door to the true distinction between body and mind, which no one has explained heretofore. For every body is a momentary mind, or one lacking recollection [recordatio], because it does not retain its own conatus and the other contrary one together for longer than a moment. For two things are necessary for sensing pleasure or pain—action and reaction, opposition and then harmony—and there is no sensation without them. Hence body lacks memory; it lacks the perception of its own actions and passions; it lacks thought.[119]

18. One point is greater than another point, one conatus is greater than another conatus, but every instant is equal to every other one. Hence time is measured by uniform motion in the same line, although its parts do not stop in an instant but are dense [indistantes], as are angles in a point.[120] These parts the Scholastics, perhaps after the example of Euclid, called signs, because there appear in them things that are simultaneous in time but not in nature, since one is the cause of the other. Likewise in accelerated motion, which increases at every instant and therefore at the very beginning; but to increase presupposes an earlier and a later. So one sign is necessarily earlier than another at the same given instant, even though without distance or extension. . . . No one can easily deny the inequality of conatuses, but from this the inequality of points follows. One conatus is obviously greater than another, or one body, moving more rapidly than another, obviously passes through more space from the beginning, for, if it passes through the same amount at the beginning, it will always continue to pass through the same amount, for motion continues as it begins unless some external cause changes it, by No. 9. Then, too, if the beginnings are equal, the ends are also equal; therefore, at the moment of collision the fast one will act upon the slow one only as much as

the slow one on the fast, which is absurd. They must therefore be unequal. The stronger body will therefore pass through more space than the slower at a given instant. But in one instant no conatus can pass through more than a point, or a part of space less than any given part, otherwise it would pass through an infinite line in time. Therefore one point is greater than another.[121] . . .

19. If two conatuses occurring at the same time can be conserved, they are compounded into one, and the motion of each is conserved. This is clear in a sphere rolled along a plane, where the motion of each point designated on the surface of the sphere is compounded from a straight line and a circle, combined through minima or conatuses into a cycloid.[12[illegible]] . . . This argument deserves to be treated more carefully by geometricians, so that it may be made clear what new curves may be produced by combining the conatuses of any given curves; thus many new geometric theorems could perhaps be demonstrated.

20. A moving body impresses upon another, without any diminution of its own motion, whatever the other can receive without losing its own earlier motion. . . .

21. If there is not something which can act simultaneously upon everything else, and be the cause of everything equally, and if there is no third thing involved, there is no action. This is the cause of rest. . . .

22. If conatuses that cannot be compounded are unequal, they are subtracted from each other, the direction of the stronger being conserved. . . . For two conatuses can be subtracted from each other, since the less is equal to a part of the greater, and hence, as long as a resolution of the problem is found in a part of either conatus, there is no reason for choosing a third solution.

23. If two conatuses that cannot be compounded are equal, the directions of both will be destroyed, or a third will be chosen intermediate between the two, the velocity of conatus being conserved. This is, so to speak, the peak of rationality in motion, since the problem is solved not merely by a crude subtraction of equals but

also by the choice of a more fitting third possibility, and so by a kind of remarkable but necessary wisdom, such as is not easily shown in the whole of geometry or phoronomy.[123] Therefore, since everything else depends on the one principle that the whole is greater than its part, Euclid prefaced the Elements by saying that the rest can be solved by addition and subtraction alone. But this principle, along with No. 20, depends on the noblest of all, namely:

24. That there is nothing without a reason. The consequences of this principle are that as little as possible should be changed, that the mean is to be chosen between contraries, that whatever is added to one thing need not even be subtracted from another, and many other things that are important in civil science as well.

II

AN EXAMPLE OF DEMONSTRATIONS ABOUT THE NATURE OF CORPOREAL THINGS, DRAWN FROM PHENOMENA

Late 1671

[K., pp. 141-42]

By the word thing we mean that which appears, hence that which can be understood; because when we are deceived and recognize our error, we may still rightly say that something has appeared to us but not that it has existed.

The nature of a thing is the cause, in the thing itself, of its appearances. Hence the nature of a thing differs from its phenomena as a distinct appearance differs from a confused one, and as the appearance of parts differs from the appearance of their positions or their relations to the outside; or as the plan of a city, looked down upon from the top of a great tower placed upright in its midst differs from the almost infinite horizontal perspectives with which it delights the eyes of travelers who approach it from one direction or another. This analogy has always seemed excellently fitted for understanding the distinction between nature and accidents.[124]

What men call a body must be investigated carefully, for a clear and distinct idea of this gives us access to demonstrations. First of all, men agree that only what is thought of as extended can be called a body. Yet all men hold that wherever they think of empty extension alone, there is no body but only empty space. And they think that the space remains when one body leaves it and another takes its place, even if they sense the contrary. Whether this derives from the prejudices of childhood needs to be made clear. Moreover, they think of a body whenever they think of something else besides space or extension alone which appears to them, for mere extension never appears to them without being invested with some color, or conatus, or resistance, or some other quality. At first glance it occurs to no one that these are merely species of extension, and therefore we must not assume it any more than we assume that all bodily changes are merely local movements. This must be demonstrated.

Therefore we think of a body whenever we think of extension being somewhere but at the same time think of a phenomenon. We can, of course, think of bodies which are not perceptible to us. But we think of all these as imperceptible, either because they are not located conveniently to us or because they are too large or too small. But for these same reasons we can also certainly say that bodies are perceptible (even if not in themselves but merely in their externals), if we think we should see them even if nothing were changed in them, but only in things external to them, as in us and the medium. So, for example, we believe we should be able to see fish in the bottom of the sea if we could descend there; hence we also believe that they are there.

Men call space something which they think is extended but nothing else, unless it be immutable. For they think that, when everything else is changed, that is, is sensed to have stopped or begun, space is sensed as neither stopping nor beginning but that it is always sensed as long as sentient beings are attending to it (that is, want to sense it) and as long as they retain the faculty of sense or are able to sense. Indeed, they think that this is the only way in which they can sense it and that, even if they might wish to, they can never think of it as anything but what would be sensed never to move as long as they attended to it. Space is therefore something extended which we see that we cannot think of as changing.

A body is something in space (that is, something not apart from some space), which we perceive we cannot think of without space, though we can think of space without it. But can we think of space without any body? We can, but only in the same way that we think of God, the mind, the infinite. These are known, and hence thought of, but without any image. We think of space in a body, but, because we think of space remaining the same when a body changes, we perceive space and body to be distinct.

However, space and body are distinct. For we perceive that we think of space as the same when bodies change, and what we perceive ourselves to be thinking or not thinking we perceive truly.[125] For the perception of thought is immediate to the thought itself in the same subject, and so there is no cause of error. Therefore it is true that we think of space remaining the same when bodies change and that we can think of space without a body which is in it. Now two things are diverse if one can be thought of without the other. Therefore space and body are diverse.

Let no one think that this demonstration is like Descartes's effort to demonstrate the existence of God from the idea in his mind. It will be worth while to show the difference briefly. Descartes's argument reduces to this. I think (clearly and distinctly) of a perfect being. Whatever I think (clearly and distinctly) is possible. Therefore a perfect being is possible. Again, if something is possible, that without which it cannot be thought (that is, that without which it is impossible) is necessary. But a perfect being cannot be thought of without its existence. Therefore the existence of a perfect being is necessary. The perfect being is God. Therefore the existence of God is necessary.

He could have condensed this as follows. An existing being is possible. That without which it is not possible is necessary. An existing being without existence is not possible. Therefore the existence of an existing being is necessary. Who would deny it? But, also, who would conclude from it that God is, since, namely, we have already assumed that he is? But Descartes's entire reason obviously reduces to this. For he asserts that God is perfect only because he thinks that this proposition contains the proposition that God exists. But he has not yet proved that God is perfect in the sense that he already exists; this in turn rests on the question whether he exists.

Our reasoning is entirely different, although it does proceed from an idea in our mind to the truth of things. For it rests on these two propositions: whatever is perceived clearly and distinctly is possible, and whatever is immediately sensed is true. Or whatever the mind perceives within itself, it perceives truly. Hence if the mind dreams that it is thinking, it will be truly thinking; however, it will not be truly seeing if it dreams it is seeing. Therefore, when I sense that I am thinking clearly and distinctly of space remaining the same when a body[109] changes, I am sensing truly. What I sense clearly and distinctly is possible; therefore it is possible for space to remain the same when a body changes. Therefore space and body are different. . . .

9

Letter to Magnus Wedderkopf

May, 1671

Leibniz's starting point in the principle of harmony, and the metaphysical consequences which he draws from it, are explicit in this letter to a jurisconsult in Kiel with whom he corresponded briefly. The implications of Leibniz's determinism for the problems of freedom and of evil are briefly treated.

* * *

[PA., II, i, 117-18]

Fate is the decree of God or the necessity of events. Those events are fatal which will necessarily happen. Both views are difficult—that a God who does not decide everything, or that a God who does decide everything, should be the absolute author of all. For if he does decide everything, and the world dissents from his decree, he will not be omnipotent. But if he does not decide everything, it seems to follow that he is not omniscient. For it seems impossible that he should suspend his omniscient judgment about anything. If we frequently suspend our judgments, this happens out of ignorance. Hence it follows that God can never be purely permissive. It follows also that there is no decree of God which is really not absolute. For we suspend our judgments with conditions and alternatives because we have insufficiently explored the circumstances of the problem.

Is this conclusion hard? I admit it. What of it? Pilate is condemned. Why? Because he lacks faith. Why does he lack it? Because he lacks the will to attention. Why this? Because he has not understood the necessity of the matter (the utility of attending to it). Why has he not understood it? Because the causes of understanding were lacking. For it is necessary to refer everything to some reason, and we cannot stop until we have arrived at a first cause—or it must be admitted that something can exist without a sufficient reason for its existence, and this admission destroys the demonstration of the existence of God and of many philosophical theorems.

What, therefore, is the ultimate reason for the divine will? The divine intellect. For God wills the things which he understands to be best and most harmonious and selects them, as it were, from an infinite number of all possibilities.[126]

What then is the reason for the divine intellect? The harmony of things. What the reason for the harmony of things? Nothing. For example, no reason can be given for the ratio of 2 to 4 being the same as that of 4 to 8, not even in the divine will. This depends on the essence itself, or the idea of things. For the essences of things are numbers, as it were, and contain the possibility of beings which God does not make as he does existence, since these possibilities or ideas of things coincide rather with God himself. Since God is the most perfect mind, however, it is impossible for him not to be affected by the most perfect harmony, and thus to be necessitated to do the best by the very ideality of things.

This in no way detracts from freedom. For it is the highest freedom to be impelled to the best by a right reason. Whoever desires any other freedom is a fool. Hence it follows that whatever has happened, is happening, or will happen is best, and also necessary, but, as I have said, with a necessity which takes nothing away from freedom because it takes nothing from the will and from the use of reason. No one has the power to will what he wills, even though he can sometimes do what he wills. Indeed, no one wants this liberty of willing what to will for himself, but rather of willing the best. Why then do we invent for God that which we do not want for ourselves? It is thus clear that an absolute will which does not depend upon the goodness of things is a monstrosity; there is, on the contrary, no permissive will in an omniscient being, except insofar as God makes himself conform to the ideality or the bestness [optimitate] of things.

Therefore nothing is to be considered absolutely evil; otherwise God would not be supremely wise in grasping it or supremely powerful in eliminating it. I have no doubt that this was the opinion of Augustine. Sins are evil, not absolutely, not to the world, not to God—for otherwise he would not permit them—but only to the sinner. God hates sins, not in the sense that he cannot bear the sight of them as we cannot bear the sight of things we detest—otherwise he would eliminate them—but in the sense that he punishes them. Sins are good, that is, harmonious, taken along with their punishment or expiation. For there is no harmony except through contraries.

But this is said to you; I should not like to have it get abroad. For not even the most accurate remarks are understood by everyone.[127]

10

Letter to Antoine Arnauld

Early November, 1671
(Selection)

"The great Arnauld," Jansenist opponent of the Jesuits and acknowledged to be the outstanding philosophical and theological controversialist of the time, was at the height of his fame and activity when Leibniz addressed his first letter to him. The occasion was a plan to promote Catholic support for the proposed Catholic Demonstrations (No. 5). Arnauld's criticisms in his later correspondence were to be influential in sharpening Leibniz's thought (Nos. 35 and 37), but there is no evidence that he replied to this letter. Only that part of this long and rather boastful writing is here translated which outlines Leibniz's intellectual opinions and motives. The section on physics restates some of the conclusions in the New Physical Hypothesis (No. 8, I), and further sections build his psychology upon it.

* * *

[G., I, 71-74]

. . . Amid so many distractions, there is nothing, I think, upon which I have brooded more earnestly over the course of my life, however short, than the problem of assuring my security in the future, and I confess that by far the greatest cause of my philosophizing as well has been the hope of winning a prize not to be disdained—peace of mind—and the ability to say that I have demonstrated certain things which have heretofore merely been believed or even, in spite of their great importance, ignored.

I saw that geometry, or the philosophy of position, is a step toward the philosophy of motion and of body and that the philosophy of motion is a step toward the science of mind. Therefore I have demonstrated some propositions of great importance about motion, of which I shall here state two. First, there is no cohesion or consistency in bodies at rest, contrary to what Descartes thought, and, furthermore, whatever is at rest can be impelled and divided by motion, however small. This proposition I later extended still further, discovering that there is no body at rest, for such a thing would not differ from empty space. From this there follows a demonstration of the Copernican hypothesis and many other novelties in natural science. The other proposition is that all motion in a plenum is homocentric circular motion and that no rectilinear, spiral, elliptical, oval, or even circular motion around different centers can be understood to exist in the world, unless we admit a vacuum. It is unnecessary to speak of the rest here. I mention these because something follows from them which is useful for my present purpose. From the latter principle it follows that the essence of body does not consist in extension, that is, in magnitude and figure, because empty space, even though extended, must necessarily be different from body. From the former it follows that the essence of body consists rather in motion, since the concept of space involves nothing but magnitude and figure, or extension.

In geometry I have demonstrated certain fundamental propositions on which depends a geometry of indivisibles, that is, a source of discoveries and demonstrations. These are that any point is a space less than any given space; that a point has parts, though these are dense [indistantes]; that Euclid was not wrong in speaking of parts of extension; that there are no indivisibles, yet there are nonextended beings; that one point is greater than another point, but in a relation less than any which can be expressed, or incomparable to any sensible difference; that an angle is the quantity of a point. From the phoronomy of indivisibles I added to these that the relation of rest to motion is not that of a point to space but that of nothing to one; that a conation is to motion as a point is to space; that there can be several conations at once in the same body but not several contrary motions; that at the time of its conatus a single point of a moving body may sometimes be in many places or many points of space or in a part of space greater than itself; that whatever moves is never in one place, not even in an infinitesimal instant; that, if one body strives against another, this is the beginning of mutual penetration or union or that the boundaries of the two are one, as Aristotle defines a continuum (οὗ τὰ ἔσχατα ἕν). Hence all those bodies—and only those—cohere which press upon each other. There are also certain momentary parts or signs, a conception which can be understood from continuously accelerated motion which increases at every instant and hence at the very beginning. For to increase connects the earlier and the later state. At a given instant one sign is necessarily prior to another, but without extension, that is, without any distance between the signs whose ratio to any sensible time whatever is greater than any given quantity, or as that of a point to a line.[128]

From these propositions I reaped a great harvest, not merely in proving the laws of motion, but also in the doctrine of mind. For I demonstrated that the true locus of our mind is a certain point or center, and from this I deduced some remarkable conclusions about the imperishable nature of the mind, the impossibility of ceasing from thinking, the impossibility of forgetting, and the true internal difference between motion and thought. Thought consists in conation, as body consists in motion. Every body can be understood as a momentaneous mind, or[129] mind without recollection. Every conatus in bodies is indestructible with respect to direction [*determinatio*];[130] in mind it is also indestructible with respect to the degree of velocity. As the body consists in a sequence of motions, so mind consists in a harmony of conations. The present motion of a body arises from the composition of preceding conations; the present conatus of a mind, that is, will, arises from the composition of preceding harmonies into a new one or through pleasure. If this harmony is disturbed by another conatus impressed upon it, the result is pain. I hope to demonstrate these and many other matters in the *Elements of Mind* which I am undertaking. From this I make bold to promise some light for the defense of the mysteries of the Trinity, the Incarnation, Predestination, and the Eucharist, of which I shall speak last of all.

My mode of life has itself compelled me to try to investigate moral problems and to establish the foundations of justice and equity with somewhat more clarity and certainty than is usual. I am working on a *Nucleus of Roman Law*, which presents in its own words, concisely and in good order, that which is truly law in the entire *Corpus*, both what is new and what is purviewed—all this as a sample of a new *Perpetual Edict* which can be enacted even now. In addition, I am thinking of recapitulating the *Elements of Roman Law* in a short table which presents, at a single glance, the few clear rules the combination of which can solve all cases, and, furthermore, new arguments for abridging lawsuits—all these far more expediently, efficiently, thoroughly, and naturally [οἰκειότεραι], so to speak, than has been proposed anywhere, in my opinion. In addition to these, I am planning to treat the *Elements of Natural Law* in a short book in which everything will be demonstrated from definitions alone. I define a good man or a just man as one who loves all men; love as pleasure derived from the happiness of others, and pain from the unhappiness of others; happiness as pleasure without pain; pleasure as the sense of harmony; pain as the sense of disharmony [*inconcinnitas*]; sense as thought with will or with a conation to act; harmony as diversity compensated by identity. For variety always delights us if it is reduced to unity. From these I deduce all the theorems of justice and equity. That is legal which a good man can do. That is due which a good man must do. Hence it is clear that the just man, the man who loves all, necessarily strives to please all, even when he cannot do so, much as a stone strives to fall even when it is suspended. I show that all obligation is fulfilled by the supreme conation; that to love others and to love God, the seat of universal harmony, is the same; indeed, that it is the same to love truly or to be wise, and to love God above all things; this is to love all or to be just. If the benefits of several people interfere with each other, that person is to be preferred from whose help the greater good in the end follows. Hence in case of conflict, other things being equal, the better man, that is, the one who loves more generally, is to be preferred. For whatever is given him will be multiplied by reflection so as to benefit many people, and therefore many will be helped by helping him. In general, other things being equal, he is to be preferred who is already satisfied. For it may be shown that benefiting others proceeds at the rate, not of addition but of multiplication. If two numbers, one greater than the other, are multiplied by the same number, multiplication adds more to the larger. . . . Therefore the larger the number that is multiplied by the same multiplier, the greater is our gain. This difference between addition and multiplication has important applications in the doctrine of justice. For to benefit is to multiply, to harm is to divide, for the reason that the person benefited is a mind, and mind can apply each thing in using it, to everything, and this is in itself to expand or to multiply it. . . .

11

Letter to Simon Foucher with Notes on Foucher's Reply to Des Gabets

1675

Leibniz's intellectual achievements during the four years he spent in Paris, from March, 1672, to September, 1676,[131] cannot be fully appraised until his papers from that period are completely published. The general impression that he forsook philosophy for mathematics is wrong; indeed, it contradicts his whole conception of the relation between the two fields. While his mathematical studies were advancing under the guidance of Huygens and by the reading of Pascal and Descartes, his philosophical conceptions were also being subjected to new tests and problems, for it is in this period that Malebranche produced the Recherche de la vérité and that Leibniz had opportunity for discussions with him, with Arnauld, with Foucher, and with other intellectual leaders. Now, too, he undertook a careful study of Descartes and Plato, whose Phaedo and Theaetetus he paraphrased during this period.

Simon Foucher, canon of Dijon (1644-97), had written a criticism of Malebranche's work in 1675 from the point of view of the ancient Academy; in the following year he replied to a defense of that author by Dom Robert des Gabets. Leibniz's letter to Foucher in 1675 concerns questions of subjectivism and our knowledge of the external world. His notes to Foucher's reply to Dom Robert show that his own doctrine of ideas is now related explicitly to the problems of epistemology and logic.

* * *

[G., I, 369-74]

I

I agree with you that it is important once and for all to examine all our presuppositions in order to establish something sound. For I hold that it is only when we can prove everything we assert that we understand perfectly the thing being considered. I know that such studies are not very popular, but I also know that to take the pains to understand matters to their roots is not very popular. As I see it, your purpose is to examine those truths which affirm that there is something outside of us. You seem to be most fair in this, for thus you will grant us all hypothetical truths which affirm, not that something does exist outside of us, but only what would happen if anything existed there. So we at once save arithmetic, geometry, and a large number of propositions in metaphysics, physics, and morals, whose convenient expression depends on arbitrarily chosen definitions, and whose truth depends on those axioms which I am wont to call identical; such, for example, as that two contradictories cannot exist and that at any given time a thing is as it is; that it is, for example, equal to itself, as great as itself, similar to itself, etc.

But, although you do not enter explicitly into an examination of hypothetical propositions, I am still of the opinion that this should be done and that we should admit none without having entirely demonstrated and resolved it into identities.

It is the truths which deal with what is in fact outside of us which are the primary subject of your investigations. Now in the first place, we cannot deny that the very truth of hypothetical propositions themselves is something outside of us and independent of us. For all hypothetical propositions assert what would be or would not be, if something or its contrary were posited; consequently, they assume two things at the same time which agree with each other, or the possibility or impossibility, necessity or indifference, of something. But this possibility, impossibility, or necessity (for the necessity of one thing is the impossibility of its contrary) is not a chimera which we create, since all that we do consists in recognizing them, in spite of ourselves and in a constant manner. So, of all the things which actually are, the possibility or impossibility of being is itself the first. But this possibility and this necessity form or compose what are called the essences or natures and the truths which are usually called eternal. And we are right in calling them this, for there is nothing so eternal as what is necessary. Thus the nature of the circle with its properties is something which exists and is eternal, that is, there is some constant cause outside of us which makes everyone who thinks carefully about a circle discover the same thing, not merely in the sense that their thoughts agree with each other, for this could be attributed solely to the nature of the human mind, but also in the sense that phenomena or experiences confirm them when some appearance of a circle strikes our senses. These phenomena necessarily have some cause outside of us.

But, although the existence of necessities comes before all others in itself and in the order of nature, I nevertheless agree that it is not first in the order of our knowledge. For you see that, in order to prove its existence, I have taken for granted that we think and that we have sensations. So there are two absolute general truths; truths, that is, which tell of the actual existence of things. One is that we think; the other, that there is a great variety in our thoughts. From the former it follows that we are; from the latter, that there is something other than us, that is to say, something other than that which thinks, which is the cause of the variety of our experiences. Now one of these truths is just as incontestable and as independent as the other, and, having stressed only the former in the order of his meditations, Descartes failed to attain the perfection to which he had aspired. If he had followed with exactness what I call a filum meditandi,[132] I believe that he would really have achieved the first philosophy.[133] But not even the greatest genius can force things; we must of necessity enter through the openings which nature has made, in order to avoid being lost. What is more, one man alone cannot do everything all at once, and for myself, when I think of all that Descartes has said that is excellent and original, I am more amazed at what he has done than at some things which he failed to do. I admit that I have not yet been able to read his writings with all the care that I had intended to give them, and, as my friends know, it happened that I read most of the other modern philosophers before I read him. Bacon and Gassendi were the first to fall into my hands. Their familiar and easy style was better adapted to a man who wanted to read everything. It is true that I have often glanced through Galileo and Descartes, but since I have only recently become a geometrician, I was soon repelled by their style of writing, which requires deep meditation. Personally, though I have always loved to think by myself, I have always found it hard to read books which one cannot understand without much meditation, for in following one's own thoughts one follows a certain natural inclination and so gains profit with pleasure. One is violently disturbed, in contrast, when compelled to follow the thoughts of someone else. I always liked books which contained some good thoughts, but which I could run through without stopping, for they aroused ideas in me which I could follow up in my own fancy and pursue as far as I pleased. This also prevented me from reading the books on geometry carefully; I freely admit that I have not yet been able to make myself read Euclid in any other way than one usually reads history. I have learned from experience that this method is good in general, yet I have recognized nevertheless that there are authors for whom one must make an exception, such as Plato and Aristotle among ancient philosophers, and Galileo and Descartes among our own. Yet what I know of the metaphysical and physical meditations of Descartes has come almost entirely from the reading of a number of books written in a more popular style which report his opinions. And perhaps I have not as yet understood him well. To the extent that I have read him over myself, however, it seems to me that I have at least been able to discover what he has not done or tried to do, and, among other things, this is to analyze all our assumptions. This is why I am inclined to applaud all who examine even the smallest truth to the end, for I know that it is much to understand something perfectly, no matter how small or easy it may seem. One can go very far in this way and, finally, establish the art of discovery, which depends on knowledge of the simplest things, but on a distinct and perfect knowledge of them. It is for this reason that I have found no fault with the plan of De Roberval, who tried to demonstrate everything in geometry, even some of the axioms.[134] I grant that we should not enforce such exactness upon others, but I believe that it is good to demand it of ourselves.

But I return to these truths which are primary with respect to ourselves, and first to those which assert that there is something outside of us; namely, that we think and that there is a great variety in our thoughts. This variety cannot come from that which thinks, since one thing by itself cannot be the cause of the changes occurring in it. For everything remains in the state in which it is, unless there is something which changes it. And since it has not been determined by itself to undergo certain changes rather than others, we cannot begin to attribute any variety to it without saying something which admittedly has no reason, which is absurd. Even if we tried to say that our thoughts have no beginning, we should be obliged to assert that each of us has existed from all eternity; yet we should not escape the difficulty, for we should always have to admit that there is no reason for this variety which would have existed from all eternity in our thoughts, since there is nothing in us which determines us to one variety rather than another. Thus there is some cause outside of us for the variety of our thoughts. And since we agree that there are some subordinate causes of this variety which themselves still need a cause, we have established particular beings or substances to whom we ascribe some action, that is, from whose change we think that some change follows in us. So we make great strides toward fabricating what we call matter and body.[135]

But at this point you are right in stopping us for a while and renewing the criticisms of the ancient Academy. For at bottom all our experiences assure us of only two things: first, that there is a connection among our appearances which provides the means to predict future appearances successfully; and, second, that this connection must have a constant cause. But it does not follow strictly from this that matter or bodies exist but only that there is something which gives us appearances in a good sequence. For if some invisible power were to take pleasure in giving us dreams that are well tied into our preceding life and in conformity with each other, could we distinguish them from reality before we had awakened? Now, what prevents the course of our life from being one long well-ordered dream, about which we could be undeceived in a moment? Nor do I see that such a power would be imperfect just on this ground, as Descartes asserts, to say nothing of the fact that its imperfection is not involved in the present question. For it might be a kind of subordinate power, or a demon who for some unknown reason could interfere with our affairs and who would have at least as much power over us as that caliph had over the man whom he caused to be carried, drunk, into his palace, and let taste of the paradise of Mohammed after he was awakened; after which he was once more made drunk and returned in that condition to the place where he had been found. When this man came to himself, he naturally interpreted this experience, which seemed inconsistent with the course of his life, as a vision, and spread among the people maxims and revelations which he believed he had learned in his pretended paradise; this was precisely what the caliph wished. Since reality has thus passed for a vision, what is to prevent a vision from passing for reality? The more consistency we see in what happens to us, it is true, the more our belief is confirmed that what appears to us is reality. But it is also true that, the more closely we examine our appearances, the better ordered we find them, as microscopes and other means of observation have shown. This permanent consistency gives us great assurance, but, after all, it will be only moral until somebody discovers a priori the origin of the world which we see and pursues the question of why things are as they appear back to its foundations in essence. For when this is done, he will have demonstrated that what appears to us is reality and that it is impossible for us ever to be deceived in it. But I believe that this would very nearly approach the beatific vision and that it is difficult to aspire to this in our present state. Yet we do learn therefrom how confused the knowledge which we commonly have of the body and matter must be, since we believe we are certain that they exist, but eventually find that we could be mistaken. This confirms Mr. Descartes's excellent thought concerning the proof of the difference between body and soul, since one can doubt the one without being able to question the other. For even if there were only appearances or dreams, we should be nonetheless certain of the existence of that which thinks, as Descartes has very well said. I may add that one could still demonstrate the existence of God by ways different from those of Descartes but, I believe, leading farther. For we have no need to assume a being who guarantees us against being deceived, since it lies in our power to undeceive ourselves about many things, at least about the most important ones.

I wish, Sir, that your meditations on this matter may have all the success you desire; but, to accomplish this, it is well to proceed in order and to establish your propositions. This is the way to gain ground and make sure progress. I believe you would oblige the public also by conveying to it, from time to time, selections from the Academy and especially from Plato, for I know that there are things in them more beautiful and substantial than is usually thought.

II

NOTES ON THE REPLY OF FOUCHER TO THE CRITICISM OF HIS CRITICISM OF THE RECHERCHE DE LA VÉRITÉ[136]

1676

On page 30. An idea is that by which one perception or thought differs from another with respect to its object.

On page 33. Though they are not extended, ideas can serve the mind to know extension, for there can be a relation between what is extended and what is not, as, for example, between an angle and the arc by which it is measured.

On page 39. Idea can be taken in two senses; namely, for the quality or form of thought, as velocity and direction are the quality and form of movement; or for the immediate or nearest object of perception. Thus the idea would not be a mode of being of our soul. This seems to be the opinion of Plato and the author of the Recherche. For when the soul thinks of being, identity, thought, or duration, it has a certain immediate object or nearest cause of its perception. In this sense it is possible that we see all things in God and that the ideas or immediate objects are the attributes of God himself. These formulas or modes of speaking contain some truth, but to speak correctly it is necessary to give constant meanings to the terms.[137]

On page 56. The author says that traces are necessary for us to conserve a memory of things. But this does not seem so certain to me. Those who ascribe memory to the separate soul will not agree to it. By what trace does the soul remember that it has been and has thought?

On page 63. The author seems to reason as follows. When we speak of being, thought, etc., the traces of these words are not naturally joined to the ideas. Therefore there must be some traces which are joined immediately to the ideas. But perhaps they can be joined immediately without being joined naturally. One must investigate the means we might use to make men who do not understand our language grasp the meaning of the words: to be and to think. This would be done, it seems to me, by showing them specimens and giving them negatively to understand that the words which we use signify what they experience or perceive in themselves or in the things, over and above what they see, hear, or touch. Thus they can be made to understand these words, not through traces but through the negation of traces. Once understood, these words will serve as traces, though arbitrary, for the future. It would be necessary to observe more exactly how infants learn language by hearing adults and without an interpreter. . . .

On page 120. The author is right in saying that thought is not the essence of the soul, for a thought is an act, and since one thought succeeds another, that which remains during this change must necessarily rather be the essence of the soul, since it remains always the same. The essence of substances consists in the primitive force of action, or in the law of the sequence of changes, as the nature of the series consists in the numbers.[138]

12

Selections from the Paris Notes

1676

The many philosophical notes which Leibniz made in Paris have been only imperfectly and very incompletely published. Those translated here were edited by I. Jagodinski in 1913. Written hastily, often reflecting the excitement of initial, untested exploration, with sentences incomplete and opinions sometimes reversed within the same fragment, they indicate the entire range of Leibniz's metaphysical problems—that of the infinite in space and time, that of the metaphysical foundations of a logic of analysis and synthesis and its compatibility with a genuine individualism. Leibniz takes a critical attitude toward the Cartesian and Spinozistic dualism of extension and thought. There is a strong interest in self-experience, which serves to offset the continuing trend toward monism and immanentism.

* * *

I

February 11, 1676

[Jag., pp. 28-40]

After rightly weighing matters, I set up as a principle the harmony of things, that is, the principle that the greatest possible quantity of essence exists. It follows that there is more reason for the existent than for the nonexistent and that all things are in the extreme state that is possible for them. For since something exists, but all possibles cannot exist, it follows that those things exist which contain the most essence, since there is no other reason for choosing them and excluding others.[139] So there will exist, before all things, the being that is the most perfect of all possible beings.

The reason is obvious, moreover, why most perfect beings should exist before all things, because, being at once both simple and perfect, or including a maximum, they leave room for many others. Hence one perfect being is to be preferred to many equivalent imperfect beings, because, since the latter occupy space and time, they impede the existence of others. From this principle it already follows that there is no vacuum of forms; likewise there is no vacuum in space and time to the extent that this is possible. Hence it follows that no time can be designated in which something does not occur, and no space which is not full, as long as this can be true. We must therefore see what follows from the fulness of the world. But above all we will prove necessarily that besides fluids there also exist solids, for these are more perfect than fluids, since they contain more essence. But not all things can be solid, for then they would impede each other. There are therefore solids mixed in with fluids. It does not seem possible to explain the origins of solids from the motion of fluids alone. All solids seem (if I may say so in passing) to be informed with a certain mind. . . .

Whether atoms seem consistent with reason? If any atom once subsists, it will always subsist, for the surrounding liquid matter will strive to dissipate it because its motion is agitated, as can easily be shown. If any large body which resists dissipation to some extent moves in a liquid, it will at once form a kind of island and a vortex. It seems to follow from a solid in a liquid that perfectly fluid matter is nothing but a multitude of infinitely small points or of bodies less than any assignable ones, or that there is necessarily an interspersed metaphysical vacuum; this does not conflict with a physical plenum. A metaphysical vacuum is an empty place, however small, yet true and real. A physical plenum is consistent with an unassignable metaphysical vacuum. Perhaps it follows from this that matter is divided into perfect points or into all the parts into which it can be divided. No absurdity follows from this, for it would follow that a perfect fluid is not a continuum but discrete or a multitude of points. From this it does not further follow that the continuum is composed of points, since liquid matter will not be a true continuum, though space will be. Hence it is clear, further, how great the difference between space and matter. Matter alone can be explained by a plurality without continuity. And matter seems in fact to be a discrete being. For, though it is assumed to be solid, matter taken without a cement, through the motion of another body, for example, will be reduced to a state of liquidity or divisibility. Hence it follows that it is composed of points. This I prove as follows: every perfect liquid is composed of points, because it can be dissolved into points, namely, by the motion of the solid within it. Matter therefore is discrete being, not continuous. It is merely contiguous and is united by motion or by some mind.

There seems to be a certain center to the whole universe, and an infinite general vortex, and a most perfect mind, or God. And this mind is a whole in the whole body of the world; to it is due also the existence of the world. It itself is its own cause. Existence is nothing but that which is the cause of organized sensations. The reason for the world is the aggregate of requisites of all things. Concerning the one, concerning God. The whole infinite is one. That particular minds exist amounts merely to this—that the highest being judges harmoniously and that what he understands exists somewhere or that there is a certain intellectual mirror or a reduplication of the world. To exist is nothing other than to be harmonious; the mark of existence is organized sensations.

From the fact that something exists, it follows that there is some necessity for it, and hence either that all things are necessary in themselves (which is false) or that their ultimate causes are necessary. Hence it follows that an absolutely necessary being is possible or does not imply a contradiction. It follows therefore that it exists. Whence it is already to be seen whether this being can be demonstrated to be unique, etc. Furthermore, since some things exist, and certain things do not exist, it follows that there must exist most perfect *Elements of a Secret Philosophy of the Whole of Things*, geometrically demonstrated. . . .

God is not a kind of imaginary metaphysical being, incapable of thought, will, and action, as some make him. This would be the same as to say that God is nature, fate, fortune, necessity, or the world. But God is a definite substance, a person, a mind.

These meditations could be entitled *On the Secrets of the Sublime*, or also *De summa rerum*. It was the extreme abstractions of certain imagined philosophers, who reduced God to a kind of imperceptible nothing, that caused Vorst, indignant against opinions so chimerical and contrary to the divine honor, to make God corporeal and inclose him in a definite place in order to show that he is a substance and a person.[140] It must be shown that God is a person or substance, an intelligence. It must be demonstrated rigorously that he feels himself to act upon himself. For there is nothing more admirable than for the same being to feel and to be acted upon by himself.

The whole labyrinth about the composition of the continuum must be unraveled as rigorously as possible; see the book of Fromond.[141] Treatment of the angle of the tangent, for this discussion belongs not to geometry but to metaphysics. We must see whether it can be demonstrated that there is something infinitely small yet not indivisible; from the existence of such a being there follow wonderful things about the infinite; namely, if we assume creatures of another, infinitely small world, we will be infinite in comparison with them. Hence we can clearly be assumed to be infinitely small in comparison with another world of infinite magnitude, yet bounded. Hence it is clear that the infinite is other than the unbounded, as we surely assume popularly.

This unbounded infinite should more rightly be called the immensum. It is remarkable that one who has lived an infinite number of years can have had a beginning and that one who lives a number of years greater than any infinite number can sometime die. From this it would follow that there is an infinite number. From another viewpoint, it is known that the number is necessarily infinite if a liquid is really divided into parts infinite in number. But if this is impossible, it will follow too that a liquid is impossible. Since we see that the hypothesis of infinites and infinitesimals turns out to be consistent in geometry, this also increases the probability that it is true.

All possibilities cannot be understood distinctly by anyone, for they imply a contradiction. The most perfect being is that which contains the most. Such a being is capable of ideas and thoughts, for this multiplies the varieties of things like a mirror. Hence God is necessarily a thinking being, and, if he is not a thinking being, the whole will be more perfect than he. An omniscient and omnipotent being is the most perfect. A thinking being is therefore even necessary, and some things which do not exist are at least thought —those, namely, worthy to be thought above others; and so, since every possible event is thinkable, some are nonetheless chosen which will be thought in reality. There are beautiful discoveries and clever images of the harmony of things. That has most harmony which is most pleasing to the most perfect of minds. If God is mind or person, it follows by reason of God and of the other minds that there must exist whatever can be demonstrated about the supreme state, whose king is most wise and most powerful. Hence no one in the world need ever be wretched unless he wills to be. It seems consistent with our reason that only he will remain wretched who wills to do so. . . . All things are good for him who believes, who loves God, who trusts in God. All things are good, not merely in general but also in particular, to whoever understands this. I do not see why eternal damnation is not consistent with the harmony of things. It is possible for this damnation to be of infinite duration but not unterminated. And this is probable and is consistent with the harmony of things.

It does not seem credible that any mind whatever should undergo all possible variations and sometime be wretched and evil; for it also does not seem that the fates of all are equalized, since whatever displeases the understanding of the wise man should, it seems, also displease God. For it seems to be reasonable that the wise man should be content. It does not seem that the wise man will be content, however, if he knows that he will sometime be wretched, or if he doubts whether he has not already been wretched sometime or will be hereafter—unless we say that this can be understood only of the past. And anyone whatever who is wise and happy at the present moment ought to be certain that he never will be either unwise or unhappy. Every relapse is a sign that he who has relapsed never was truly wise. From this it follows that all happiness is unbounded but that no wretchedness is without limits, though it can be eternal. And so the blessed will be happy for a longer time than the doomed will be unhappy, since the grace of God consists of the abundant gift of the will. For happiness is in the power of him who has a good will. . . .

Every mind is of unbounded duration. Every mind also is implanted indissolubly in certain matter. This matter is of definite magnitude. Every mind has a vortex around it. All the mundane spheres are perhaps endowed with mind; such intelligences do not seem absurd. The objection too is that they will not have sufficiently free motion, but, since they understand their duty (officium) and communicate with God through the mutual influences of the bodies which they sense, they will not affect a variety of motion. Everywhere there are innumerable minds. There are minds in the human egg even before conception, and they are not lost even if conception never takes place. We are ignorant of the wonderful uses to which things are destined by providence. . . .

II

April, 1676

[Jag., pp. 94-99]

Extension and thought are complex forms, for existence, duration, etc., are common to them.[142] Both thinking and extension have duration in common, but it is remarkable that one form is more highly structured than another. Thus forms differ in this respect: some involve more relations and some less. For example, thought has both subject and object, extension has merely a subject. Yet it seems that consciousness itself is something per se, just as is extension per se, namely, status; for in consciousness subject and object are the same. If it is true that there is no memory without traces and that the traces in bodies of thoughts about incorporeal things are not natural but arbitrary, or characters[143] (for there is no necessary connection of representation between the incorporeal and the corporeal), it follows that there is no knowledge or reasoning without characters, because all reasoning or demonstration takes place through a memory of premises. But, as we have assumed, there is no memory without characters or images. . . .

A remarkable thing, that the subject is something other than forms or attributes. This is necessary because nothing can be said about forms because of their simplicity. Therefore no proposition would be true unless forms are united in a subject. Thought is not duration, but a thinking being is an enduring one. And in this consists the difference between substance and forms. It is to be seen whether thought is rightly said to endure, to change, to be. . . . Any simple form whatever is an attribute of God. There are necessarily simple forms or perceptions per se, because if things are perceived only through others, and these others again are perceivable only through others still, and so forth, nothing at all will be perceived. In those things in which there is variety, such as color, there is a reason why this variety is not perceived distinctly by us. This is because we perceive color in a definite period of time. But this time can be subdivided into infinite parts, in each of which we do something pertaining to the perception, which we do not remember, however, because of a defect in our organs. But the things which are perceived in a single act, such as being, perception, extension, are understood perfectly. . . .

. . . Rightly understood, forms are conceived per se, and subjects through forms. This is what subjects are. But that whose modifications depend on the attributes of something else, in which, namely, all its requisites are contained, is certainly conceived through something else; that is, it cannot be perfectly understood except by understanding another. Two things are connected if one cannot be understood without the other. Those things are requisites which connect something else, but not the converse. A reason is the sum of requisites. Sensible things cannot be perfectly understood by us, because an infinite number of things concur in constituting them, since time and space are infinitely divisible. Hence the perception of a sensible quality is not one perception but an aggregate of infinites. . . .

. . . Aristotle saw that a separate intellect does not remember, because there is no memory without imagination. For my part, it seems to me that there is some memory per se of our perception but not of a perception of variety. And so there will be neither joy nor grief without images, and no images without reminiscence. . . . It seems to me that without memory nothing that happens after death pertains to us. So there will be some memory after death, such as there is in falling asleep. This operation of the mind seems most remarkable to me. It seems that when I think of myself thinking and already know, between the thoughts themselves, what I think of my thoughts, and a little later marvel at this triplication of reflection, then I turn upon myself wondering and do not know how to admire this admiration. . . . It sometimes happens that I cannot forget something, but involuntarily think of the same thing for almost an hour, and then think of this difficulty in thinking and stupefy myself into reflections through perpetual reflections, so that I almost begin to doubt that I shall ever think of anything else and begin to fear that this direction of mind has harmed me. . . . Anyone who desires an experience of these matters should begin to think of himself and his thinking sometime in the middle of the night, perhaps when he cannot sleep, and think of the perception of perceptions and marvel at this condition of his, so that he comes gradually to turn more and more within himself or to rise above himself, as if by a succession of spurts of his mind. He will wonder that he has never before experienced this state of mind. We are thus never without other perceptions than sense, for we sense within ourselves this direction of the mind by which we are led back within ourselves and suppress externals. The fatigue which accompanies pure thought certainly often arises from this. I have noticed further that this perception of perception also occurs without characters and therefore that memory does also. For to perceive perception, or to sense that I have sensed, is to remember, as Hobbes says. I do not yet adequately experience how these different acts of the mind take place, in this continually reciprocating reflection, as it were, in the intervals between these acts, but they seem to be made by a distinguishing sense of the bodily direction. But if you observe well, this act will merely make you remember that you already had this in mind a little previously, that is, this reflection of reflection, and so you observe it and designate it by a distinct image accompanying it. Therefore it already was in your mind earlier, and so perception of perception goes on perpetually in the mind to infinity. In it consists the existence of the mind per se and the necessity of its continuation.

III

April 15, 1676

[Jag., pp. 108-10]

In our mind there is perception or a sense of itself as of a certain specific thing; this is always in us, because, as often as we make use of a word, we at once recognize it. As often as we will, we recognize that we perceive our thoughts, that is, that we have thought a little earlier. Therefore intellectual memory consists not in what we sense but in that we sense—that we are those who sense. This is what we commonly call identity. This faculty in us is independent of externals. I do not see how a man or a mind can die or be extinguished while these reflections last. Something remains in modifications, not as extension in itself remains in space, but as a certain particular thing endowed with definite modifications, since, namely, it perceives one thing or another. This sense of one's particular self is without other characters, because I know it well when I think and reflect. . . . If this is the nature of mind, and it consists in the perception of itself, I do not see how it can ever be impeded or destroyed, as I have said earlier, because the identity of the mind is not destroyed by any changes and therefore is not destroyed by anything—as can easily be shown. I therefore believe that the solidity or unity of a body comes from the mind and that there are *as many minds* as vortices, as many vortices as there are solid bodies. A body resists, and this resistance is sense. The body namely resists the impulsion to divide. Sense is a kind of reaction. An incorruptible body and mind alike. Various organs around it are changed variously. . . . My opinion is that all true beings or minds, which alone are unities, increase always in perfection and that every impression which is made on the body has an effect into infinity. Minds will be for a while reduced into themselves; then they will return, perhaps to the sense of external things, perhaps to some far different nature. Sometime there will be an intercourse of all the spheres of the world with each other. In this theater minds will advance to more and more perfection. It is impossible to believe that the effect of all perceptions will ever disappear, since the effect of all other actions lasts always. This would happen only if the mind were obliterated.

So I do not accept Spinoza's opinion that the individual mind is extinguished with the body, for mind somehow remembers what has preceded, and this is over and above what is merely eternal in mind—the idea of the body, or its essence. . . .

IV

April, 1676

[Jag., pp. 120 ff.]

Simple forms: perception and situs. But change and matter, or modifications, themselves, are resultants from all the other forms taken at the same time. For they vary infinitely in matter and motion. This infinite variety can arise only from an infinite cause, that is, from various forms. It is easily understood from this that simple forms are infinite. The modifications, however, which result from all forms, when related to individuals, constitute the variety in them. . . . Perception and situs seem to be everywhere, but matter seems to be diversified into this order or that, and thus there arises this set of laws or that; as, for example, the law in our order that the same quantity of motion is always conserved. There can be another order of things, in which there are also other laws. But one space nonetheless differs from another, for there will be a certain position and plurality, but will not necessarily be width, breadth, or depth. We already see that in time, in the angle, and in other things, the kinds of quantities have new varieties. . . . Everywhere there seems to be perception, joy, happiness. For this is the remarkable nature of it—that it duplicates, indeed, multiplies, into infinity the variety of things. But diversity seems to be possible in other ways which do occur to our minds.

God is the subject of all absolute simple forms; absolute, that is, affirmative. There are therefore two things in God: that which is one in all forms, and essence or the collection of forms. Obviously one and the same God is absolutely ubiquitous or omnipresent, absolutely enduring or eternal, absolutely active or omnipotent, and absolutely existent or perfect. To be is in some way to think in relation to something. No one is unless he is something. To whatever existence is absolutely ascribed, i.e., existence without a determinate addition, to that as much existence must be ascribed as possible, that is, the maximum.

. . . As space is to the immensum, so the collection of all minds is to the active intellect. God is primary intelligence insofar as he is omniscient, or insofar as he contains that absolute affirmative form which is ascribed by limitation to all others who are said to perceive something. In this manner God is the immensum itself, insofar as a perfection is ascribed to him (that is, this absolute affirmative form) which is discovered in things when they are said to be somewhere, to be present. . . .

God is not a part of our mind, just as the immensum is not a part of a certain place or interval. Just as God is that which perceives perfectly whatever can be perceived, or is intelligence, so God is also that which is somewhere perfectly wherever something can be. Just as God is intelligence, therefore, he is also this immensum. Furthermore, universal space is being by aggregation, just as is the universal state, or the society of all minds. But there is a difference here, since position or a spatial interval can be destroyed . . . but the soul cannot be destroyed. Whatever acts cannot be destroyed, for at least it lasts while it acts; therefore it will last always. Whatever suffers and does not act can be destroyed; so place, figure, body, and every aggregate can be destroyed. There seem to be elements or indestructible bodies because there is mind in them. As a figure is already in the immensum before it is marked off, so an idea or the differentia of thoughts is already in the primary intelligence. As a figure is in space, just so an idea is in our mind. There is no world soul, because there can be no continuum composed of minds, as there can be of spaces. . . . Ideas are in our mind as differentiae of thoughts. Ideas are in God insofar as the most perfect being consists in the conjunction of all absolute forms or possible perfections in the same object. But from this conjunction of possible simple forms there result modifications, that is, ideas, as properties from essence. Simple forms are infinite, because our perceptions are infinite, and they cannot be explained out of the mutual relation of the two. Thus no one can explain, from the knowledge of perception and extension alone, what we sense in red, bright, hot, nor can this ever be done except then, when. . . . In us joy is a sense of increased perfection; in God joy is perfection itself, the whole possessed together. . . . It seems that the total perfection of minds always increases, while that of bodies is not increased, for such increase would be in vain, and this is the true reason a priori why forces always remain constant, powers always remaining the same while our knowledge does not.

Whether mind is the idea of the body? This cannot be, because mind remains while the body continuously changes. And of what body should it be the idea; why not rather of all that it perceives? . . .

The idea of existence and identity does not come from the body; neither does that of unity. A remarkable thing, that mind remembers negatives, or is conscious that it has not thought of something.

It seems to me that the origin of things from God is like the origin of properties from essence; since 6 is 1 + 1 + 1 + 1 + 1 + 1, it follows that 6 = 3 + 3 = 3 x 2 = 4 + 2, etc. And we cannot doubt that one of these expressions differs from another, for thinking in one way we think expressly of 3 or 2, and in another way we do not think of the same numbers. . . . Just as these properties differ from each other and from their essence, therefore, so also do things differ from each other and from God. I use the word "thing" deliberately, for we customarily say that God is a being; we do not usually call him a thing.[144] . . .

13

Letter to Henry Oldenburg

December 28, 1675

Henry Oldenburg was one of the secretaries of the London Royal Society and a correspondent of Spinoza and other scholars. Leibniz had exchanged letters with him intermittently since 1670, receiving from him important information about the affairs of the Royal Society and other matters of scholarly interest in England. It was Oldenburg who in 1676 transmitted the two letters of Newton upon which the later charge of plagiarism of the calculus was based. The present letter is an early proposal by Leibniz of his plan for a universal characteristic or science of symbols. It also suggests that a casual reading of Robert Boyle prompted him to return to his earlier project of an Elementa de mente.

* * *

[GM., I, 83-84]

I am indebted to you for your two letters, and I ask you not to take my silence too ill. For I am often interrupted and take up these studies only at intervals.

Your sending Tschirnhaus to us is a token of your friendship, for I take great delight in his company and recognize outstanding ability in the youth. His discoveries are very promising, and he has shown me a number of elegant ones in analysis and geometry. I can easily judge from this what may be expected from him. Long ago he asked me, in writing to you, to beg your indulgence for his silence. And I should add in his behalf that he has not lacked diligence in studying the manuscripts of Roberval, Pascal, and Fermat, though he has in part lacked success.[145] . . .

I ask you to commend me to the illustrious Mr. Boyle when occasion offers. I esteem him as highly as the virtue and learning of man can be esteemed. I recently read his diatribe, "That Theological Studies Are Not To Be Condemned"; it made a deep impression on me and confirmed me in the purpose, which you know I already had a long time ago, of treating the science of mind through geometric demonstrations. I have made many remarkable observations in this field and shall sometime publish them, presented with the rigor which they deserve.

I cannot reconcile myself to certain Cartesian views on this subject. Descartes builds many things upon ideas which I suspect of being sophisms. But in the body, too, there is something necessary besides extension. The distinction between mind and matter is therefore not yet clear from the distinction between thought and extension. But another principle has been given us by the nature of things, from which the perennial duration of the mind can be established by direct demonstration. Whatever the conclusions which the Scholastics, Valerianus Magnus, Descartes, and others derived from the concept of that being whose essence it is to exist, they remain weak as long as it is not established whether such a being is possible, provided it can be thought. To assert such a thing is easy; to understand it is not so easy. Assuming that such a being is possible or that there is some idea corresponding to these words, it certainly follows that such a being exists. But we believe that we are thinking of many things (though confusedly) which nevertheless imply a contradiction; for example, the number of all numbers. We ought strongly to suspect the concepts of infinity, of maximum and minimum, of the most perfect, and of allness [omninitas] itself. Nor ought we to believe in such concepts until they have been tested by that criterion which must, I believe, be credited to me, and which renders truth stable, visible, and irresistible, so to speak, as on a mechanical basis. Such a criterion nature has granted us as an inexplicable kindness.

Algebra, which we rightly hold in such esteem, is only a part of this general device. Yet algebra accomplished this much—that we cannot err even if we wish and that truth can be grasped as if pictured on paper with the aid of a machine. I have come to understand that everything of this kind which algebra proves is only due to a higher science, which I now usually call a combinatorial characteristic,[146] though it is far different from what may first occur to someone hearing these words. I hope sometime, given health and leisure, to explain its remarkable force and power by rules and examples. I cannot encompass the nature of the method in a few words. Yet I should venture to say that nothing more effective can well be conceived for perfecting the human mind and that, if this basis for philosophizing is accepted, there will come a time, and it will be soon, when we shall have as certain knowledge of God and the mind as we now have of figures and numbers and when the invention of machines will be no more difficult than the construction of geometric problems. And when these studies have been completed—though there will always remain to be studied the choicest harmonies of an infinity of theorems, but by observation from day to day rather than by toil—men will return to the investigation of nature alone, which will never be entirely completed. For in experiments good luck is mixed with genius and industry.

Once men carry our method through to the end, therefore, they will always philosophize in the manner of Boyle, except insofar as nature itself, to the degree to which it is known and can be subjected to this calculus and to the degree that new qualities are discovered and reduced to this mechanism, will also give to geometricians new material to which to apply it. But the enthusiasm of writing is carrying me further than I intended and makes me speak somewhat incoherently.

14

Two Notations for Discussion with Spinoza

1676

On his prolonged journey from Paris to Hanover by way of England and Holland, Leibniz visited Spinoza and, as he wrote to the Abbé Gallois in 1677, "spoke with him several times and for very long."[147] The terminology and ideas in the following notations correspond closely to those of the Paris notes, but the problems arise out of Spinoza's views. They contain an effort to find a firmer basis for the ontological argument and point to the distinction between logical possibility and compossibility in existence.

* * *

I

THAT A MOST PERFECT BEING EXISTS

November, 1676

[G., VII, 261-62; PA., II, i, 271-72]

By a perfection I mean every simple quality which is positive and absolute or which expresses whatever it expresses without any limits.[148]

But, because a quality of this kind is simple, it is unanalyzable or indefinable, for otherwise either it will not be one simple quality but an aggregate of many or, if it is one, it will be contained within limits and hence will be understood through negation of what is beyond these limits; which is contrary to hypothesis, since it is assumed to be purely positive.

From this it is not difficult to show that all perfections are compatible with each other or can be in the same subject.

For let us assume that there is a proposition of this kind: A and B are incompatible, understanding by A and B two simple forms or perfections of this kind. It makes no difference if more than two are assumed simultaneously. It is clear that this proposition cannot be demonstrated without an analysis of the terms A and B, either or both, for otherwise their nature would not enter into the reasoning, and incompatibility could be demonstrated equally as well about any other things as about themselves. And by hypothesis they are unanalyzable. Therefore this proposition cannot be demonstrated about them.

But it could certainly be demonstrated about them if it were true, since this proposition is not true by itself. For all propositions which are necessarily true are either demonstrable or known per se. Therefore this proposition is not necessarily true, or it is not necessary that A and B should not[149] be in the same subject. Therefore they can be in the same subject. And, since this reasoning is the same for any other assumed qualities of this kind whatsoever, it follows that all perfections are compatible.

Therefore there is, or can be conceived, a subject of all perfections or a most perfect being. Hence it is clear that this being exists, since existence is contained in the number of perfections.[150]

[Leibniz later added the following notes.]

The same can be shown also of forms compounded out of absolutes, provided there are any. I showed this reasoning to Mr. Spinoza when I was in The Hague. He thought it sound, for, when he contradicted it at first, I put it in writing and gave him this paper.

Scholium. Descartes's reasoning about the existence of a most perfect being assumed that such a being can be conceived or is possible. If it is granted that there is such a concept, it follows at once that this being exists, because we set up this very concept in such a way that it at once contains existence. But it is asked whether it is in our power to set up such a being, or whether such a concept has reality and can be conceived clearly and distinctly, without contradiction. For opponents will say that such a concept of a most perfect being, or a being which exists through its essence, is a chimera. Nor does it suffice for Descartes to appeal to experience and allege that he experiences this very concept in himself, clearly and distinctly. This is not to complete the demonstration but to break it off, unless he shows a way in which others can also arrive at an experience of this kind. For whenever we inject experience into our demonstrations, we ought to show how others can produce the same experience, unless we are trying to convince them solely through our own authority.

Propositions for which a demonstration is needed.

Prop. 2. Two substances with diverse attributes have nothing in common with each other.

Prop. 5. There cannot be in the universe two or more substances with the same attribute.

Prop. 10. Every attribute of a single substance must be conceived through itself.

Prop. 22, 23. About infinite modes.

Sch. 31. Intellect and will must be referred to natura naturata and not to natura naturans.

Part 2, 19, 20 seem to conflict. However, 26: Therefore there is an idea of an idea. 29, 49.

II

December 2, 1676[151]

[Cout. OF., pp. 529-30]

There is no need of many worlds to increase the multitude of things, for there is no number which is not contained in this one world and, indeed, even in any one of its parts.

To introduce another kind of existing things, and another world, so to speak, which is also infinite, is to abuse the word "existence," for we cannot say whether or not these things exist now. But existence as it is conceived by us involves some determinate time, or we say that a thing exists precisely if we can say about it at some definite moment of time, "This thing exists now."[152]

A multitude of things is greater in the whole than in a part; this is true in an infinite multitude as well. It is not useless to discuss the vacuum of forms, in order to show that not all possibles can exist per se along with others; otherwise many absurdities would follow. Nothing, however unreasonable, could be conceived which would not be in the world, not merely monsters but evil and wretched minds, and injustices, and there would be no reason for calling God good rather than evil, just rather than unjust. There would be some world in which all good people would be punished by eternal punishments, and all people rewarded, or wickedness expiated by happiness.

The immortality of the mind must be taken as proved at once by my method, because it is possible within itself and compossible with all other things, or it does not impede the course of things. For minds have no volume. My principle, namely, is that whatever can exist and is compatible with other things does exist, because the reason for existing in preference to other possibles cannot be limited by any other consideration than that not all things are compatible. Thus there is no other reason for determining existences than that the more perfect shall exist, that is, those things which involve the greatest possible reality.

If all possibles existed, no reason for existing would be needed, and possibility alone would suffice. Therefore there would be no God except insofar as he is possible. But such a God as the pious hold to would not be possible if the opinion of those is true who believe that all possibles exist.

PART II

HANOVER TO THE ITALIAN JOURNEY

1676-87

15

ON A METHOD OF ARRIVING AT A TRUE ANALYSIS OF BODIES AND THE CAUSES OF NATURAL THINGS

May, 1677

The first of the three rulers under whom Leibniz served at Hanover also allowed him the greatest freedom for his own intellectual activities. The few years preceding John Frederick's death late in 1679 were among the most creative in his life, involving many studies for the revived Catholic Demonstrations and for the new projects of a universal characteristic, a logical calculus, and an encyclopedia. Among these studies is a short paper applying the method of analysis and synthesis to physical and chemical problems, in which the empirical and utilitarian motives in his thought are expressed. Leibniz's conception of experimental controls and of the pragmatic limits of chemical as opposed to physical analysis is noteworthy. His interest in chemistry may have been revived at this time by the discovery of phosphorus, on which he first reported in the same year.[153]

* * *

[G., VII, 265-69]

First of all, I take it to be certain that all things come about through certain intelligible causes, or causes which we could perceive if some angel wished to reveal them to us. And since we may perceive nothing accurately except magnitude, figure, motion, and perception itself, it follows that everything is to be explained through these four. But because we are now speaking of those things which seem to take place without perception, such as the reactions of liquids, the precipitations of salts, etc., we have no means of explaining them except through magnitude, figure, and motion, that is, through mechanism. What cannot be explained in this way will here be referred to the action of some perceiving being. Let us imagine, therefore, that some angel comes to explain to me the true cause of magnetic declination and the periods observed in it. He will surely not really satisfy me by saying that this is the nature of the magnet or that there is a certain sympathy or a kind of soul in the magnet by which it happens. Rather he must explain some cause to me, such that, if I understand it, I can see that the phenomena follow from it as necessarily as the cause of the hammer stroke when a given time has elapsed follows from my knowledge of a clock.

Bodies that are composite in appearance, such as a plant or an animal, are to be reduced to bodies simple in appearance, such as flesh, tendons, glands, blood. Bodies that are simple in appearance are to be reduced to those out of which or by the combination of which they can be produced. Thus brass, as it is called, is made out of copper and zinc under the action of fire and air, and vitriol from sulfur or some other acid, and copper or iron.

Since there is a circle involved in the processes of composition and production—for example, sulfur can be produced again from vitriol, and we do not yet know whether vitriol is prior in nature to sulfur or sulfur to vitriol—it should be sufficient for us to determine a certain few classes [species] from which we can artificially produce a variety of other classes and sensible qualities. For an effect is understood when its cause is understood. Hence we can explain all remaining classes perfectly and mechanistically from these few classes, if we know accurately what happens in the process of preparation.

Among the other ingredients we must also count the general agents and instruments—fire, air, water, earth—without which we cannot treat or prepare anything. We must note also which kinds of fire, air, water, and earth intervene, and reduce these also to a few simple ones. For it is certain that air contributes considerably to fire, that lime increases its weight by fire, that some subtle force penetrates even glass, as in congealment, and that crystals take on something from water, since they spring up in solutions. The vessels also contribute something to changes in preparations. Finally, the effect of coal fire is different from that of the fire of a torch.

When the same effect is produced by the use of different ingredients or instruments, this effect is to be explained by something which they have in common. When all things, or at least most of them, have been reduced to certain few classes such as saltpeter, common salt, sulfur, potash, soot, spirit of wine, then it will be necessary merely to institute or describe as many experiments as possible to observe what happens when these classes are combined with each other; for example, when common salt is put into soap, which is made by using potash and fat, earth is precipitated and the fat floats on the water.

As many experiments as possible are to be carried out isolatedly, that is, as experiments in which, besides one single homogeneous body, nothing enters into the process but the general and necessary agents. Next, after the isolated experiments are completed, as many experiments as possible are to be tried with only two kinds taken together, as with saltpeter and common salt alone, treating them in various ways by fire, water, air; and by combining various products thus made, for instance, combining the products made with salt with each other as well as with those made with saltpeter. After combinations, one should go on to the conternations, etc., or to the ternions and quaternions of the classes.[154]

All experiments in which only a few elements are brought together are more useful for science than others, because it is easier to discover in which element the cause lies hidden. In experiments made by the combination of several bodies, one must see whether anything can be altered or eliminated without changing the results of the experiment, as linseed oil, for example, from the ironmaking experiment.

Those experiments are to be tried first in which the analogy to other experiments promises some special effect. It is likely that things which are similar in many known factors will also be similar, or at least approximately so, in other factors not yet examined, but which seem to have a connection with the factors already tried. But whether or not the result does show such similarity in the remaining factors, we will always profit.

It is possible that bodies which are exceedingly subtle and cannot be caught or perceived by sense in one substance can be caught in another. Thus the gas of wine cannot yet be captured, but one can catch the gas of other bodies. In animals, too, we find certain vessels and organs to be invisible in some species but distinctly noticeable in others.

Especially are those experiments to be interpreted the success of which is reliable and infallible. All experiments reported by others are also to be entered in a catalogue, provided these experiments are certain and approved by common consent and very distinctly described.[155]

Bodies and preparations made from them are to be examined by means of the instruments of experimentation—scales, thermometers, hygrometers, pneumatic pumps—and also by vision, whether naked or fortified, by smell, and by taste. I believe there is no medium more effective than taste for discerning the essential nature of bodies, because taste brings bodies to us in their substance and dissolves them in us so that we may perceive the whole solution closely.

Not only microscopes are to be used but perfectly polished concave and spherical mirrors of very large radius. The magnifying power of lenses varies inversely with their diameters; that of mirrors, on the contrary, in direct proportion. Now diameters can be increased to infinity but not decreased. Hence mirrors are more useful. Then, too, only the surface needs to be good in mirrors, and, last of all, the whole body can be made visible in one mirror, which is not possible in a microscope.

Probably the causes of what happens in bodies—especially in those homogeneous in appearance—are not very complex, and, if some angel were to unveil them and explain them to us, we should perhaps be astonished that we had not discovered them earlier ourselves. So it is also probable that those bodies which are homogeneous in appearance are not so complex that we must despair of discovering their inner structure insofar as this is necessary for our many purposes.

Although bodies may be divided into other subtler bodies to infinity, and it is incredible that there should be any primary elements, this ought not to prevent us from seeking causes. He who uses stones in architecture does not mind the bits of earth interposed between them; he who uses water in hydraulics pays no attention to the air in it, which can afterward be extracted by the Guericke pump; and he who uses earth to raise a rampart does not think of the small stones scattered about in it but which do not bother him. So we may believe that the effect of those very subtle bodies within the bodies which we handle are no more relevant to the phenomena than are stones, or even the imperceptible corpuscles which compose earth, to the strength of a bulwark.

If the invisible bodies which are hidden in visible ones and which enter noticeably into the effect of our experiments were of so many kinds, then they would also be very subtle. And if they were so subtle, they would change in the briefest moment, and bodies such as saltpeter and sulfur would not remain so long in the same state or continue to produce the same experimental results. If those bodies which contribute in causing the phenomena were so inaccessible to us and so subtle, then some slight and superficial mixture of two liquids could not produce such great effects, or else it would follow that any mixture whatever could also produce the greatest effects.

The physical effects may be considerably intensified and reduced through slight mechanical manipulations, such as shaking, stirring, beating, blowing, pouring in water; for example, water suddenly poured over oil of vitriol produces amazing heat which it does not make when slowly added in drops. Bodies are greatly changed by trituration. All of these things are sure indications that the bodies which our crude manipulations make perceptible so easily are not so inaccessible to us.

Analysis is of two kinds—one of bodies into various qualities, through phenomena or experiments, the other of sensible qualities into their causes or reasons, by ratiocination. So, when undertaking the most accurate reasoning, we must seek the formal and universal causes of qualities which are common to all hypotheses and must begin accurate but universal enumerations of all possible modifications, such as those of weight, elasticity, light or heat, coldness, liquidity, firmness, tenacity, volatility, fixity, solubility, precipitation from menses, crystallization. If we combine these analyses with experiments, we shall discover in any substance whatever the cause of its qualities. But this can be very effectively achieved through definitions and a philosophic language.[156]

16

Letter to Arnold Eckhard

Summer, 1677

Soon after his arrival in Hanover, Leibniz was sought out by a zealous Cartesian, Arnold Eckhard, professor of mathematics at Rinteln. Gerhard Molanus, the genial and learned abbot of Loccum, near Hanover, brought the two men together for a philosophical discussion of the Cartesian conception of being, particularly of the argument from God's essence to his existence. Eckhard is one of the Cartesian Scholastics to whom Leibniz later refers as the first recipients of his criticisms of Descartes.

This letter is a careful reply to a very long one by Eckhard in May, 1677, and contains the essence of the extensive comments which Leibniz made on that letter, several of which are given here as notes.[157] Leibniz was as much concerned as Eckhard to find a sound basis for the ontological argument, but his objections are a step in the clarification of his own logical and metaphysical pluralism.

* * *

[G., I, 266-70]

As soon as I received your most learned and weighty, rather than lengthy, letter, I at once consumed the whole. For there is nothing which I will read with more pleasure than things written so elegantly and soundly about an argument of such importance. I should have replied more fully had not the most reverend Abbot of Loccum given me the hope that a formal demonstration would follow. I preferred to wait for this, but, since the demonstration has not yet arrived, I have decided to make this brief reply meanwhile, so that you may understand that I have received your letter and have read it studiously.[158]

Several of my objections have ended since you have explained that, in your usage, perfection is being insofar as it is understood to differ from nonbeing, or, as I should prefer to define it, *perfection* is degree or quantity of reality or essence, as *intensity* is degree of quality, and *force* is degree of action. It is clear, also, that existence is a perfection or increases reality, that is: when *A* is thought of as *existing*, more reality is thought of than when *A* is conceived as *possible*.[159] But it still seems to follow from this that there is more perfection or reality in a mind which suffers than in an indifferent one which is neither enjoying nor suffering, so that, in a metaphysical sense, pain too is a perfection. But since pleasure is also a metaphysical perfection, it seems that we must ask whether pain or pleasure is the greater perfection, metaphysically speaking. It seems that *pleasure* is the greater perfection, because it is the consciousness of power, while *pain* is the consciousness of powerlessness. But powerlessness, again speaking metaphysically, is an imperfection, and the consciousness of metaphysical imperfection is less perfect, again speaking metaphysically, than the consciousness of metaphysical perfection. So pain implies a certain imperfection in the suffering subject. But there remain certain scruples even here, which I pass over for now.

I hasten to the heart of the question, which is whether *a most perfect being does not imply a contradiction*. You have undertaken to prove this because neither Descartes nor any of the Cartesians have done it, though I have often urged them to do so. You have chosen the best way to prove it, for if you show that the concept of the most perfect is not composite, you will have concluded also that it does not imply a contradiction. Therefore you promise to set up a certain concept which is known to be the most simple yet also to contain all of reality. The concept which you set up is this: a most perfect being is either a being by itself [*a se*] or a necessary being, because it is self-determined to everything of which it is capable. This concept, you say, does not imply a contradiction (1) because it is distinct, for its individual parts are clear, (2) especially since everyone classifies being into that which is by itself and that which is through something else, and there must therefore necessarily be some idea underlying these two; otherwise men would speak like parrots. (3) Besides, we know what it means to be through something else or to be determined to something by something else; therefore we must also know what it means not to be determined by something else. (4) Furthermore, we know by experience that the concept to be determined by itself does not imply a contradiction, for we experience this every day in our own volitions. (5) Also, pure actuality is simpler than an actuality mixed with potentiality. Therefore, since the latter does not contain an implied contradiction, the former will much less contain one. (6) Nothing more is even required for a most perfect being, you add, than that it be a most perfect mind, that is, a mind to which belong all the perfections which are found in any mind. For every substance is either mind or body; but a being which determines itself is not a body, therefore it will be a mind. A most perfect mind, that is, a mind which understands and wills most perfectly, most certainly does not imply a contradiction. To understand most perfectly, or to understand all things, does not imply a contradiction, because to understand implies none. Likewise, to understand all things at any time in a single act does not imply a contradiction, because to understand many things sometimes in a single act does not imply one. Nothing conflicts with understanding itself but nonunderstanding, perfect nonunderstanding. Also, a mind endowed with the most perfect will, or a mind whose power reaches as far as his will, does not imply a contradiction. For the contrary of power is not omnipotence but impotence. Because therefore a being which determines itself to everything of which it is capable is a most perfect mind, and hence most perfect in its willing, or omnipotent, it follows that all other realities come from it. So you also prove the second part of your assertion, namely, that the concept which you set up of a most perfect being not only implies no contradiction but also produces every other perfection or contains it virtually. Having shown these points, (7) you also prove the existence of a most perfect being by a different method, from the existence of certain contingent beings; for example, from the existence of our minds or of the world. For such beings must necessarily have received their existence from one whose nature is such that all things come from it.

If I am not mistaken, these points, which you have expounded very clearly and elegantly, contain a summary of your reasoning. I shall state frankly and sincerely what I find still to be desired for a demonstration of absolute perfection. To (1) I reply that for a distinct concept it is not enough that all its parts are clear, unless it is also clear that they can be combined with each other. Thus whoever speaks of a maximum velocity knows what velocity is and what a maximum is, yet he cannot understand maximum velocity, for it is easy to demonstrate that this implies a contradiction. To (2): just as those who speak of a maximum velocity do not speak like parrots, although they are speaking of something for which there is no possible concept, so, it may be objected, do also those who speak of being by itself. To (3): it does not follow that, if the existence of one of two opposite terms is intelligible, the other is also intelligible, for it is possible that the opposite term implies a contradiction. This happens, for instance, if you classify men into rational and irrational, or bodies into mobile and immobile. So too if you classify being into that which is through something else and that which is not through something else. For your opponents may say that whatever is necessarily is through something else. To (4): so far it is very doubtful whether our will is determined by ourselves or not rather by the impressions of objects.[160] To (5): this seems to be a sophism. By the same reasoning a maximum velocity would be pure and therefore simpler in kind than a velocity combined with slowness; yet the former velocity implies a contradiction, while a velocity combined with slowness does not. If the matter is rightly considered, pure actuality involves many important things, namely, as many powers as there are things to which the being must determine itself, and also the power to exclude and, so to speak, repel external powers. Hence you see how slippery the argument is that only nonactuality is incompatible with actuality and that therefore pure actuality is not, as if it were certain that all actualities and all potentialities are compatible with each other. The opponents believe that such beings, in which we accumulate, as it were, all perfection and all actuality, are chimerical. To (6): this assumes without proof that all substance is either mind or body. But this is not certain, even though we may never have thought of any other substance. For perhaps there can be others of which we can no more think than a blind man thinks of colors. To prove that a mind which understands all things and wills most perfectly, or is omnipotent, does not imply a contradiction, you make use of the same paralogism which you use above, if I am not mistaken, namely, that nonunderstanding is opposed to understanding, but that to understand everything at once and always is not. By the same argument you may prove that an eye which would see everything always and at once is possible.[161] It is the same when you say that the opposite of power is impotence, not omnipotence. So much about your proof that the concept of a being which determines itself does not imply a contradiction.

The proof by which you maintain that the being which determines itself also determines all other beings seems to be weaker, however, and less well formulated. For it reduces to this: a being which determines itself to everything of which it is capable cannot be a body. Therefore it is a mind, etc. (Here you assume what is not at all demonstrated, namely, that every substance is either a body or a mind.) Furthermore, since it is a mind, and not just any mind, it must be some particular mind; therefore what other than the most perfect one? (That this mind is possible, you tried to prove by the paralogism which I have mentioned.) But this does not follow, for it is possible that the property of determining itself to everything of which it is capable may belong to other minds in common with a perfect mind. For a being determining itself is not by that fact alone the most perfect, since it is possible that there may be some other being more perfect than it, which also determines itself to everything of which it is capable. For a more perfect mind, capable of more things, would also determine itself to more things. But, you say, the most perfect mind is omnipotent; it can do everything or determine all other things. Therefore there cannot be more than one self-determining mind. I reply that you have not proved that such a most perfect mind is possible, and, besides, it is enough for the perfection of a mind to know everything and be able to do everything that it wills. But it does not follow therefrom that it should be able to do everything, because it may not will everything, for it may not will what it understands is not within its power; that is, it may not will to determine those things which are already determined by themselves.[162] The reasoning in (7) assumes that such a most perfect being, source of all being, is possible, and so it does not need a separate reply.

These are the answers which can be given summarily in reply to your argument, so that you may see the scruples which I have so far had about the whole thing almost visually tabulated. As for the rest, you have made many fine comments on which I shall not now touch. To many of the ideas which you have mixed in throughout, I cannot give my assent; for instance, the Cartesian doctrine that eternal truths depend on the will of God. In my opinion this is either error or a mere play of words.[163] You offer many clear considerations on the nature of action, power, necessity, immutability, eternity, will, thought, pleasure, and pain which must be praised, not refuted. But I have made note of a few things here and there which will, I believe, be welcome to you, and which I shall send you some other time so that you may have a richer material on which to exercise the gifts of genius. In short, I believe that Descartes does not prove the possibility of a most perfect being, which is the first desideratum in this argument; indeed, he does not even try. So I hold that what you have done here is not Cartesian but your own. I do not see that you have done this, as you say, by the Cartesian method. What, I pray, is this Cartesian method which some people boast about so frequently? And what does he have of which the rest of us are ignorant or which all good thinkers born before Descartes did not use? Were Archimedes and Galileo Cartesians, perchance? I admit that Descartes founded a method in geometry, though one not so very different from Vieta's, and far from perfect. For it cannot touch innumerable problems which are both most important and most useful. It is false that every problem can be reduced to an equation which can then be represented by a curve of the kind admitted by Descartes. I esteem the genius and the discernment of Descartes highly, but he tried to convince the world that the things which he achieved by virtue of his outstanding ability were done solely through the use of a certain unique method which he had established, so that men were drawn to the hope of discovering an art by which mediocre minds could equal excellent ones. In fact, it seems to me that almost no Cartesian has produced anything which even remotely approaches the discoveries of the master. The outstanding advances which have been made since Descartes are not due to his method; by some ill chance, in fact, they seem to have been made by almost anyone rather than Cartesians. Therefore, distinguished Sir, I am unwilling to do you and other excellent philosophers the injury of regarding as Cartesian any outstanding work which you produce. I observe that, whenever men become too devoted to one author, they usually block the paths of further progress for themselves. . . .

17

DIALOGUE

August, 1677

The dialogue form had interested Leibniz in Paris, where he had paraphrased Plato, and he tried his hand at it frequently during the following years. BC. fittingly calls the present one a "Dialogue on the Connection between Things and Words." Aimed explicitly at Thomas Hobbes's position that truth is arbitrary, but also indirectly at Descartes's view that truth rests upon God's arbitrary will, the dialogue probably grew out of the correspondence with Eckhard. It develops the theory of characters, their use in reasoning, and their bearing upon the nature of truth. The problem of error is lost sight of as the dialogue progresses. As the use of the term "express" suggests, the position reached here is important in the development of the theory of representation.

* * *

[G., VII, 190-93]

A. If you were given a thread and told to bend it in such a way that it shall form a closed line and shall include the greatest possible inclosed space, how would you bend it?

B. In a circle, for the geometricians show that a circle is the most spacious of figures of the same circumference. If there are two islands, one circular and the other square, around which one can walk in the same time, the circular one contains more land.

A. Do you consider that this is true even if you were never to think of it?

B. Certainly, and even before the geometricians had proved it or men observed it.

A. So you think that truth and falsehood are in things, and not in thoughts.

B. By all means.

A. But then can any thing be false?

B. I do not think that things are false, but thoughts or propositions about things.

A. Then falsehood is a property of thoughts and not of things.[164]

B. I am forced to agree.

A. Why not truth also, then?

B. So it seems, but I am inclined to doubt whether this conclusion is valid.

A. When a question is proposed, do you not doubt whether or not some answer is true or false until you are certain of your opinion?

B. Of course.

A. You admit, therefore, that it is the same subject which is capable of truth or falsehood, until one or the other is established by the particular nature of the question.

B. I admit it and acknowledge that, if falsehood is a property of thoughts, then truth is also and not of things.

A. But this contradicts what you said before, that there is also truth which no one has thought.

B. You have confused me.

A. Yet we must attempt to reconcile the two views. Don't you think that all the thoughts that can be made are actually formed? Or, to put it more clearly, do you think that all propositions are thought?

B. I do not.

A. It seems then that truth is a quality of propositions or thoughts, but of possible thoughts, so that what is certain is only that, if anyone should think in this way or in the opposite way, his thought would be true or false.

B. You seem to have succeeded in getting us over a slippery place.

A. But since there has to be a cause for the truth or falsity of any thought, I ask you where we shall seek this cause?

B. In the nature of things, I think.

A. But what if it arises from your own nature?

B. Certainly not from my nature alone. For my own nature and the nature of the things of which I think must be such that when I proceed by a valid method I shall necessarily infer the proposition concerned or find it true.[165]

A. Your reply is excellent, but there are still difficulties.

B. Of what kind, I beg of you?

A. Certain men of learning believe that truth arises from the human will and from names or characters.[166]

B. Such an opinion is certainly most paradoxical.

A. But they prove it in this way. Isn't definition the principle of demonstration?

B. I admit this, for certain propositions can be demonstrated solely by joining definitions together.

A. Hence the truth of such propositions depends upon definitions.

B. Granted!

A. But definitions depend upon our will.

B. How so?

A. Don't you see that it is within the choice of mathematicians to use the word "ellipse" to signify a certain figure? And that it was within the choice of the Latins to ascribe that meaning to the word "circle" which its definition expresses?

B. What of it? Thoughts can occur without words.

A. But not without some other signs. Try, I pray, whether you can begin any arithmetical calculation without numerical signs.[167]

B. You disturb me very much, for I did not think that characters or signs are so necessary for ratiocination.

A. You grant then that arithmetical truths presuppose some signs or characters?

B. That can't be denied.

A. Therefore such truths depend on the human will?

B. You seem to be getting me tied up by a kind of sleight of hand.

A. These are not my ideas, but those of a very gifted writer.

B. But can anyone depart so far from a sound mind as to persuade himself that truth is arbitrary and depends on names, though he knows that the geometry of the Greeks, Latins, and Germans is the same?

A. You are right; yet the difficulty needs to be resolved.

B. There is just this one thing that makes me pause. I notice that no truth is ever known, discovered, or proved by me except by the use of words and other signs presented to the mind.

A. In fact, if there were no characters, we could neither think of anything distinctly nor reason about it.

B. Yet when we examine the figures of geometry, we sometimes establish truths merely by contemplating them accurately.

A. True, but we must recognize that these figures must also be regarded as characters, for the circle described on paper is not a true circle and need not be; it is enough that we take it for a circle.

B. Nevertheless, it has a certain similarity to the circle, and this is surely not arbitrary.

A. Granted; therefore, figures are the most useful of characters. But what similarity do you think there is between ten and the character 10?

B. There is some relation or order in the characters which is also in things, especially if the characters are well invented.

A. That may be, but what similarity do the first elements themselves have with things; for example, 0 with nothing, or a with a line? You will have to admit, therefore, that, in these elements at least, there is no need of similarity to things. This is true, for example, in the words lux and ferens; even though their compound lucifer has a relation to these two words, light and bearing, which corresponds to that which the thing signified by lucifer has to the things signified by *lux* and *ferens*.

B. But the Greek φώσφορος has the same relation to φῶς and φέρω.[168]

A. The Greeks might have used another word than this, however.

B. True. Yet I notice that, if characters can be applied to ratiocination, there is in them a kind of complex mutual relation [*situs*] or order which fits the things; if not in the single words at least in their combination and inflection, although it is even better if found in the single words themselves. Though it varies, this order somehow corresponds in all languages. This fact gives me hope of escaping the difficulty. For although characters are arbitrary, their use and connection have something which is not arbitrary, namely, a definite analogy between characters and things, and the relations which different characters expressing the same thing have to each other. This analogy or relation is the basis of truth. For the result is that, whether we apply one set of characters or another, the products will be the same, or equivalent or correspond analogously. But perhaps certain characters are always necessary for thinking.

A. Excellent! You have extricated yourself clearly and fully. And the analytic or arithmetical calculus confirms this view. For in numbers the problem always works out in the same way whether you use the decimal system or, as some mathematician did, the duodecimal. Afterward, if you apply the solution you have reached by calculation in several different ways, by arranging kernels or some other countable objects, the answer always comes out the same. In analysis as well, even though different properties of the subject are more easily apparent when different characters are used, the basis of truth is always found in the connection and coordination of these characters. So, calling the square of a, a^2, and substituting $b + c$ for a, we have $b^2 + c^2 + 2bc$ as the square. But if we substitute $d - e$ for a, we will have $d^2 + e^2 - 2de$ as the square. In the former case we express the relation of the whole, a, to its parts b and c; in the latter the relation of the part, a, to the whole, d, and the excess, e, of the whole, over the part, a. Yet by substitution it becomes apparent that the calculation always leads to the same result. For if we substitute in the formula $d^2 + e^2 - 2de$ (which equals a^2), its equivalent $a + e$ for d, we shall have $a^2 + e^2 + 2ae$ for d^2, and $-2ae - 2e^2$ for $-2de$. So, adding these together,

$$\begin{aligned} +d^2 &= a^2 + e^2 + 2ae \\ +e^2 &= e^2 \\ -2de &= -2e^2 - 2ae \end{aligned}$$

the sum produced is . . . . $= a^2$.

You see, then, that however arbitrarily the characters may be chosen, if you observe a certain order and rule in their use, they always agree. Therefore though truths necessarily presuppose some characters, and are indeed sometimes asserted about these characters themselves (as in the theorem about casting off nines), yet they consist not in the arbitrary element in their characters but in the permanent element in them, namely, in their relation to things. It is always true, without any arbitrary choice of ours, that, if certain characters are adopted, some definite argument must proceed, and if others are adopted whose relation to the things signified is known but different, the resulting relation of the new characters will again correspond to the relation of the first characters, as appears by a substitution or comparison.

18

Letter to Herman Conring

March 19, 1678

Herman Conring (1606-81), professor at Helmstädt, was one of the outstanding scholars and controversialists of his day, active in such diverse fields as medicine, jurisprudence (a founder of the history of law), philosophy, history, and theology. His correspondence with Leibniz had begun in 1670, when his friend Boineburg sent him a copy of the New Method of Learning and Teaching Jurisprudence. At first (before Leibniz's Paris sojourn) their letters were concerned primarily with the theory of law; even here Conring was inclined to defend the old philosophy, especially Aristotle, against Leibniz's appreciation of the new, so that this period of the correspondence ended with the impatient protest and exhortation to the venerable Aristotelian, "Let us dismiss our prejudices and honor the geniuses of all ages" (G., I, 175). Conring was engaged in theological controversy with the Capuchins at the court of Hanover when Leibniz came there in 1676 and soon resumed the correspondence. The present letter returns to the problem of the validity of Aristotle and the Scholastics and the usefulness of substantial forms for a mechanistic philosophy of nature. But it is most important for Leibniz's theory of method, particularly in the verification of truths of fact and the use of hypotheses.

* * *

[G., I, 193-99]

. . . I do not think that the function of respiration and the way in which it is necessary for life have as yet been explained satisfactorily. No one who has carefully observed the anatomy of living animals will say that respiration is the cause of the motion of the heart. Even if the heart really beats because of heat, as experience confirms, it is not yet clear where heat comes from in an animal, how it is conserved, and how it acts. To derive heat from the motion of the blood and thus from the motion of the heart again would be to commit a vicious circle. It seems therefore that the phenomenon must be reduced to some kind of fermentation, or to a reaction and conflict, which, some authors think, arises from the mixture of old blood and new chyle. I should have liked your opinion about this rather than about the question of whether the motion of the heart comes from respiration, which I had not raised. But it remains to ask whether the air in the lungs supplies something to the blood, or whether it merely supports the temperature, somewhat in the way in which chemical furnaces need some ventilation.

I come to your criticisms regarding analysis and demonstration. You think that I have added some very paradoxical novelties to this matter, and you sometimes doubt whether I am writing seriously. But I have in fact said only things that I have concluded about this matter from many years of experience and from instances of the reasoning of myself and others as well; things, moreover, that are consistent with what men do every day, even though they are not always aware that they are doing it. What I have proposed is effective, too, in discovery and judgment and not, like the methods and precepts of certain other men, barren and remote from applications and facts.

Demonstration is reasoning by which some proposition is made certain. This is achieved whenever it is shown that the proposition necessarily follows from certain suppositions (which are assumed to be certain). By necessarily I mean in such a way that its contrary implies a contradiction; this is the true and unique mark of impossibility. Just as necessity corresponds to impossibility, furthermore, so an identity corresponds to a proposition which implies a contradiction. For the primary impossibility in propositions is this: *A is not A*; just so the primary necessity in propositions is this: *A is A*. Hence only identities are indemonstrable, but all axioms are demonstrable, even though they are mostly so clear and easy that they do not need demonstration; nevertheless, they are demonstrable in the sense that, if their terms are understood (i.e., by substituting the definitions for the terms defined), it becomes clear that they are necessary or that their contrary implies a contradiction in terms. This is also the opinion of the Scholastics. But we know that identical propositions are necessary propositions without any understanding or analysis of their terms, for I know that *A* is *A*, whatever may be understood by *A*. All propositions, however, whose truth must be shown by further analyzing and understanding their terms are demonstrable by such analysis, that is, by definitions. So it is clear that demonstration is a chain of definitions. For in the demonstration of any proposition, nothing is used but definitions, axioms (with which I here include postulates), theorems which have been demonstrated previously, and observations. Since the theorems again must themselves be demonstrated, and axioms, except for identities, can also all be demonstrated, it follows that *all truths can be resolved into definitions, identical propositions, and observations*—though purely intelligible truths do not need observations. After the analysis has been completed, it will become manifest that the chain of demonstration begins with identical propositions or observations and ends in a conclusion but that the beginning is connected with the conclusion through intervening definitions. In this sense I said that a demonstration is a chain of definitions.

The definition of a compound idea, moreover, is an analysis of it into its parts, just as a demonstration is nothing but the analysis of a truth into other truths which are already known. And the solution of any problem which is to be worked out is the reduction of the problem to others which are easier or already known to be within one's power. This is my analysis, which has been tested in mathematics and in other sciences and will succeed. If anyone has another, I shall be surprised if it does not reduce, finally, to this one, or prove to be a part or corollary of it.

Synthesis, on the other hand, is the process in which we begin from principles and compound theorems and problems, whichever the natural order of thought presents to us, while analysis is the process in which we begin with a given conclusion or proposed problem and seek the principles by which we may demonstrate the conclusion or solve the problem.[169] Thus synthesis does not help to solve questions which turn up accidentally (except when tables of truths can be established); yet it is useful in discovering many excellent things which we may set aside for later use when some question happens to arise. For it is certain that a man who knows many of the theorems in Euclid, Archimedes, Apollonius, and others will perform the analysis more briefly than one who knows only a few fundamental propositions, even though the latter can always achieve his aim as well as the former, if he uses a sure method and is industrious enough. I have made many fine discoveries about these matters and could illustrate them with excellent examples if I had enough time. When we arrive eventually at already known truths by starting from assumptions which we did not know to be true or uncertain, we cannot conclude from this that the assumptions are true, as you rightly warn, unless we make use in our reasoning of pure equations or propositions that are convertible or whose subject and predicate are equally inclusive. We must take care, that is, not merely that the predicate is as inclusive as the subject in each proposition, and the converse (which is true in reciprocal propositions), but also that subject and predicate in one proposition are as inclusive as the subject and predicate in all the other propositions occurring in the same proof.[170] But though my comment may seem new to you, the practice of the ancients shows that they were not ignorant of this principle, for they guarded against errors adequately, even though they did not record their rules of analysis distinctly enough—not to mention the fact that their analytic writings have been lost. Equations of this kind have a place, moreover, not merely in mathematics but in all other reasoning wherever, that is, definitions occur. But those who deduce known phenomena from some physical hypothesis which has been taken for granted without demonstration cannot by this process demonstrate that their hypothesis is true, unless they have observed the condition which we have just set down. This they have not done, nor, perhaps, have they wanted or been able to do it. Yet it must be admitted that a hypothesis becomes the more probable as it is simpler to understand and wider in force and power, that is, the greater the number of phenomena that can be explained by it, and the fewer the further assumptions. It may even turn out that a certain hypothesis can be accepted as physically certain [pro physice certa] if, namely, it completely satisfies all the phenomena which occur, as does the key to a cryptograph. Those hypotheses deserve the highest praise (next to truth), however, by whose aid predictions can be made, even about phenomena or observations which have not been tested before; for a hypothesis of this kind can be applied, in practice, in place of truth. But the Cartesian hypothesis is still far from deserving this praise; I have often raised this objection with the chief Cartesians of France and Belgium—that until now nothing new has ever been discovered by the use of Descartes's principles, whether in nature or in the mechanical arts. What is more, none of the discoverers of important things was a Cartesian.

By Cartesian principles, however, I do not mean those which are common to Descartes and Democritus,[171] but only his physical hypothesis and elements. You need not wonder that Descartes should have found so many disciples all at once. For, except for Galileo, you will find no one in our century who can be compared with him, whether in genius for discovering the causes of things, in judgment in explaining the senses of the mind lucidly, or in ready eloquence in capturing the minds of more discerning men. To these things was added the fame of his profound mathematical knowledge; and though we know today that it has not been as great as the crowd of Cartesians now believe, yet it was greater than that of any other man of his time, for Vieta and Galileo had died when Descartes was flourishing. Besides, there were many people at that time who were disgusted with the Scholastic program of studies and sought to be freed from it, for Bacon and others had already prepared them for freedom. For the rest, neither Galileo, Descartes, nor Gassendi was ignorant of Aristotle's doctrines. Gassendi had certainly read the ancients more carefully than did many Aristotelians. It seems to me that no one is more ignorant of Aristotle's teachings than the so-called Aristotelians. I have always admired Aristotle's Organon, Rhetoric, and Politics. I understand that his zoölogy is esteemed by the experts and think that there are many things which we ought not to spurn in his eight books on physics, as well as in his books on the soul and on metaphysics. But I cannot value his works on the heavens and on generation and corruption highly, and I do not believe that you disagree. That the whole new philosophy is soon to be rejected by a learned posterity, as you say, is very unlikely if the world continues to advance as it has begun, unless you think, perhaps, that men will turn back again from the full fruits of discovery to their little acorns, and from things to words. This we need not fear unless a new barbarism should break out which would bring darkness into human affairs.

Who would deny substantial forms, that is, essential differences between bodies? You say that I have somewhere wrongly ascribed to you the view that forms originate out of nothing.[172] I do not remember where I did this; nor do I know why you should consider as most absurd the view that everything happens mechanically in nature, that is, according to certain mathematical laws prescribed by God. I recognize nothing in the world but bodies and minds, and nothing in minds but intellect and will, nor anything in bodies insofar as they are separated from mind but magnitude, figure, situation, and changes in these, either partial or total. Everything else is merely said, not understood; it is sounds without meaning. Nor can anything in the world be understood clearly unless it is reduced to these. Suppose that some angel wishes to explain the nature of color to me distinctly. He will accomplish nothing by chattering about forms and faculties. But if he shows that a certain rectilinear pressure is exerted at every sensible point and is propagated in a circuit through certain regular permeable or diaphanous bodies, and then teaches me exactly the cause and the mode of this pressure, and deduces the laws of reflection and refraction from it, thus explaining everything in such a way that it is clear that it could not even happen otherwise, then at last he will have increased my knowledge, since he has treated physics mathematically. Who has ever said that all the affections of natural things are quantities? Motion is not a quantity, nor is figure, though both are subjects of quantity, for figure and motion can be measured. You challenge me to reduce any genuinely sensible quality to common quantities. What else do mathematicians do when dealing with sight and hearing, where they reduce everything, as far as possible, to mechancial laws? There is still some doubt about odor and taste. Furthermore, what is more probable than that all sensible qualities are merely tactual qualities varying according to the variety of sense organs? But touch recognizes only magnitude, motion, situation, or figure and various degrees of resistance in bodies. It is always true in every science, certainly, that special qualities are nothing but common qualities, variously complicated. If these considerations do not convince you, I should like you to think of this one thing: that, unless physical things can be explained by mechanical laws, God cannot, even if he chooses, reveal and explain nature to us. For what would he say, I ask you, about vision and light? That light is the action of a potentially transparent body? Nothing is truer, even though it is almost too true. But would this make us any wiser? Could we use this to explain why the angle of reflection of light is equal to the angle of incidence, or why a ray should be bent more toward the perpendicular in a denser transparent body, though it would seem that the opposite should happen? There are other phenomena of this kind, and, if we understood their causes, I believe we should understand the nature of light. But how can we hope to explain the causes of such things except by mechanical laws, that is, by concrete mathematics or geometry applied to motion?

I do not think that we disagree on the demonstration of special matters. You say that my estimate of the Schoolmen's metaphysics would be more favorable if I had read them. Yet I esteemed them most favorably, for I had written you, if I remember well, that I believe many excellent metaphysical demonstrations are to be found in them which deserve to be purged of their barbarisms and confusion. I could not have said this if I had not wanted you to believe that I have read them. And I did in fact read them, more immoderately and eagerly than my teachers approved, when I began to study philosophy at the universities. They feared, indeed, that I should cling too tightly to these rocks. You would have found me, then, making some original and profound comments (for so they seemed to others as well) on the principle of individuation, the composition of the continuum, and the concourse of God. And I have never since regretted having sampled these studies.

I am unwilling to agree with you that Descartes only pretended to defend the existence of God and the immortality of the soul, and I do not see your grounds for inferring this. His arguments are not sophistical but imperfect; that is, he assumes some things which he has not demonstrated but which are nonetheless demonstrable, though they could not easily be demonstrated by his principles. It is certain, however, that most of his metaphysics is already found, partly in Plato and Aristotle and partly in the Scholastics. So far I have been convinced that my friend in Rinteln[173] holds the best doctrine about God and the soul, and I have no ground for changing my opinion. So I do not want you to become fixed in the opinion which you seem to have gathered from false stories which others have told about a good and scholarly man. Whether there is some incorporeal substance in beasts which is called a sentient soul is something to be investigated by experiments, for it is a question of fact. Yet if I am not mistaken, God could certainly have created a kind of machine similar to an animal which carries out, without sensibility, all the functions, or at least most of them, which we see in beasts. Conversely, we cannot assert with certainty that there is a sentient soul in beasts unless we observe phenomena which cannot be explained mechanically. If I were shown an ape who plays the game of highwayman or chess skilfully and successfully, even with men as opponents, I should certainly be forced to admit that there is something in him greater than a machine. But from that time on I should become a Pythagorean and, like Porphyry, condemn the eating of animals and the tyranny which men exercise against them. I should also provide for a place for their souls after death, for no incorporeal substance can be destroyed.

But enough of these matters for now. I have gone into greater detail about them, both to clear myself of a suspicion of being thoughtlessly inclined to adopt absurd beliefs merely because their novelty pleases me, and also to see whether a man of such great genius and discernment as yourself can voice any objection to my findings. I am concerned, as are all who wish to hold a middle ground, not to seem too much inclined toward either of the two opposed adversaries. Whenever I discuss matters with the Cartesians, certainly, I extol Aristotle where he deserves it and undertake a defense of the ancient philosophy, because I see that many Cartesians read their one master only, ignoring what is held in high esteem by others, and thus unwisely impose limits on their own ability. I do not at all approve of throwing words around too freely against the old philosophy, nor do I approve of the argument which a certain friend in this neighborhood has divulged; I have told him so in a letter, I think that the two philosophies should be combined and that, where the old leaves off, the new should begin.

Perhaps my tetragonism will some day be published in France, where I have abandoned my demonstrations.[174] It is not such as mathematicians usually desire, but such as they ought to desire, for, since it is impossible to express the ratio between a circle and a square in one number, a series of numbers continued to infinity is required. I do not think a series can be given that would be simpler than mine.

I greatly regret that your work on the boundaries of the German Empire has met with a delay, for I know that you can say some excellent things on this.[175] I hope that soon, after you have completed these and other matters which you have in hand, you may be able to write down some things in medicine and publish your praiseworthy findings in this field, which is so difficult and yet so important. Above all, I wish that a correct doctrine of the use of parts could be set up, and a pathology treating the causes and symptoms of diseases and based on observation constructed upon it. I know no one who can do this more accurately than you. But that you may be able to achieve these and other outstanding services, I wish you, from the bottom of my heart, sound health, prolonged for a very long time.

19

Letter to Walter von Tschirnhaus

May, 1678
(Selection)

After their winter of collaboration in Paris, Leibniz and Tschirnhaus continued to discuss mathematical and philosophical problems by letter.[176] On April 30, 1678, the latter wrote a long letter from Rome, in which the solution of higher equations was discussed, along with other mathematical questions. In the course of the letter it was proposed that algebra is the universal science of symbols, of which the art of combinations is but one part. Leibniz's reply contained a criticism of Tschirnhaus' proposed solution of algebraic equations, an exposition of some of the fundamental principles of the calculus, and a clear statement of the scope of his proposed characteristic science and the relation of algebra to it. Only the philosophical section of the letter is here reproduced.[177]

* * *

[GM., IV, 451-63]

. . . As I run through the rest of your letter, I notice incidentally that you write:

> Many people quite falsely believe that the art of combinations is a separate science, to be mastered before algebra and other sciences. Indeed, some people believe that there is more in the art of combinations than in the art commonly called algebra; in other words, that the daughter knows more than her mother. But it is certainly obvious, from the composition of powers alone if by nothing else, that the art of combinations is mastered through algebra.

These are your words, which are undoubtedly aimed at me, for the "many" who, as you say, think in this way are few, I believe, besides myself. However, I believe that your opinion is right because you do not seem to have understood me. For if you hold the art of combinations to be the science of finding the number of variations, I freely admit that it is subordinate to the science of numbers and consequently to algebra, since the science of numbers is also subordinate to algebra. For certainly you do not find these numbers except by adding, multiplying, etc., and the art of multiplying is derived from the general science of quantity, which some call algebra. But for me the art of combinations is in fact something far different, namely, the science of forms or of similarity and dissimilarity, while algebra is the science of magnitude or of equality and inequality. The combinatory art seems little different, indeed, from the general science of characteristics, by the use of which fitting characters have been or can be devised for algebra, for music, and even for logic itself.[178]

Cryptography is also a part of this science, although the difficulty here lies not so much in compounding as in analyzing what has been compounded, or in investigating its roots, so to speak. What a root is in algebra a key is in cryptographic divination. Taken by itself algebra has only rules of equality and proportion, but, when the problems are more difficult and the roots of equations very involved, algebra is forced to draw something again from the higher science of similitude and dissimilitude or from the science of combinations.[179] For a device to compare similar equations or equations of the same form was already known to Cardan and others and very distinctly described by Vieta; it has properly been taken from the art of combinations. But this art can be and ought to be used not only when our concern is with formulas which express magnitudes, and with the solution of equations, but also when the involved key is to be developed for other formulas which have nothing in common with magnitude. The art of finding progressions and of establishing tables of formulas is also purely combinatorial, for these have a place not only in formulas expressing magnitude but in all others as well. For formulas can also be derived from them which express situation [situs] and the construction of lines and angles without considering magnitude. More elegant constructions can be discovered by this method, and more easily, than through the computing of magnitudes. With the help of combinatorial theorems (that is, involving similarity and dissimilarity) it can be proved far more naturally than Euclid has done that the sides of triangles having equal angles are proportional.[180] Meanwhile I admit that no more beautiful example of the art of combinations can be found anywhere than in algebra and that therefore he who masters algebra will the more easily establish the general art of combinations, because it is always easier to arrive at a general science a posteriori from particular instances than a priori. But there can be no doubt that the general art of combinations or characteristics contains much greater things than algebra has given, for by its use all our thoughts can be pictured and, as it were, fixed, abridged, and ordered; pictured to others in teaching them, fixed for ourselves in order to remember them; abridged so that they may be reduced to a few; ordered so that all of them can be present in our thinking. And though I know you are prejudiced, by reasons which I do not know, to look rather adversely upon these meditations of mine, I believe that, when you examine the matter more seriously, you will agree that this general characteristic will be of unbelievable value, since a spoken and written language can also be developed with its aid which can be learned in a few days and will be adequate to express everything that occurs in everyday practice, and of astonishing value in criticism and discovery, after the model of the numeral characters. We certainly calculate much more easily with the characters of arithmetic than the Romans did, either with pens or in their heads, and this is undoubtedly because the Arabic characters are more convenient, that is, because they better express the genesis of numbers.

No one should fear that the contemplation of characters will lead us away from the things themselves; on the contrary, it leads us into the interior of things. For we often have confused notions today because the characters we use are badly arranged; but then, with the aid of characters, we will easily have the most distinct notions, for we will have at hand a mechanical thread of meditation, as it were, with whose aid we can very easily resolve any idea whatever into those of which it is composed. In fact, if the character expressing any concept is considered attentively, the simpler concepts into which it is resolvable will at once come to mind. Since the analysis of concepts thus corresponds exactly to the analysis of a character, we need merely to see the characters in order to have adequate notions brought to our mind freely and without effort. We can hope for no greater aid than this in the perfection of the mind. I wanted to write this to you a little more fully, my friend, to find out whether reasons do not carry more weight with you than prejudiced opinions. If you reply that the matter is clear but difficult, this is all I ask of you, for the difficulties do not frighten me, since I see certain, and unless I am mistaken, very appropriate means for overcoming them.

You will have learned that the posthumous works of Spinoza have appeared. There is among them a fragment On the Improvement of the Intellect, but he stopped just where I most expected something. He does not always sufficiently explain his opinions in the Ethics, for which I rather blame him. Sometimes he commits paralogisms, the cause being that he departs from rigorous demonstrations.[181] I certainly believe that it is useful to depart from rigorous demonstration in geometry because errors are easily avoided there, but in metaphysical and ethical matters I think we should follow the greatest rigor, since error is very easy here. Yet if we had an established characteristic we might reason as safely in metaphysics as in mathematics.

You say that it is difficult to set up definitions of things; perhaps you mean in the most simple and the primitive concepts, so to speak. These, I admit, it is difficult to give. We must realize, indeed, that there are several definitions of the same thing, that is, reciprocal properties which distinguish one thing from all other things and that from each one we can derive all the other properties of the thing defined. You are not unaware of this, but some of these definitions are more perfect than others, that is, they come nearer to the primary and adequate notions. Indeed, I hold this to be a certain criterion of a perfect and adequate definition: that, when the definition is once grasped, we cannot further doubt whether the thing defined in it is possible or not.

Besides, anyone who wishes to construct a characteristic or universal analytic can use any definitions whatever in the beginning, since all will eventually lead to the same result when the analysis is continued. You are entirely of my opinion when you say that in very composite matters a calculus is necessary. For this is the same as if you had said that characters are necessary, for a calculus is nothing but operation through characters, and this has its place not only in matters of quantity but in all other reasoning as well. Meanwhile I have a very high regard for such problems as can be solved by mental powers alone insofar as this is possible, without a prolonged calculation, that is, without paper and pen. For such problems depend as little as possible on external circumstances, being within the power even of a captive who is denied a pen and whose hands are tied. Therefore we ought to practice both in calculating and in meditating, and, when we have reached certain results by calculation, we ought to try afterward to demonstrate them by meditation alone, which has in my experience often been successful.

But since we think the same about many things, I have no doubt that if we differ it is with reason. I do not want this to cause dissension between us, nor dissension to diminish our friendship. I hope therefore that you will not be displeased with my frankness in expressing my opinion about your extraction of the roots of equations, for I think you have missed the mark and want to indicate this to you to save you labor. I in turn await your opinion about my own views, for I have great confidence indeed in you and have no doubt of profiting. I have learned many things from you, and I can learn even now. You are capable of great discoveries and can do the things which have already been presented by others, even by me, if you give your mind to them. But, in the public interest, I should prefer to have you apply your mind to untouched problems which are not yet in our power. I hope also that several prejudices which you seem to hold against some of my opinions will more and more disappear. . . .

20

ON THE ETHICS OF BENEDICT DE SPINOZA

1678

As the letters to Tschirnhaus and Justel show (No. 19 and n. 181), Leibniz received a copy of Spinoza's Opera posthuma from G. H. Schuller, the literary executor, immediately after their publication, and assumed a critical attitude toward both the Ethics and the essay On the Improvement of the Understanding from the start. His reading notes on Book I of the Ethics are particularly detailed and show how his concern to establish a sound logical basis for his own pluralistic view of substance impelled him to search out and criticize the logical gaps and implicit assumptions in Spinoza's arguments.

* * *

[G., I, 139-50]

Part I. On God

Definition 1. Cause of itself is that whose essence involves existence.

Definition 2. To say that a thing is finite if it can be limited by another thing of the same nature involves obscurity. For what does it mean to say that a thought is limited by another thought? Does this mean that the other one is greater, in the sense that he says that a body is limited because another can be conceived which is greater than it? See Proposition 8, below.

Definition 3. Substance is that which is in itself and is conceived through itself. This definition too is obscure. For what does "to be in itself" mean? Then we must ask: Does he relate "to be in itself" and "to be conceived through itself" cumulatively or disjunctively? That is, does he mean that substance is what is in itself and also that substance is what is conceived through itself? Or does he mean that substance is that in which both occur together, that is, that substance is both in itself and conceived through itself? But then it would be necessary for him to prove that whatever has one property also has the other, while the contrary seems rather to be true, that there are some things which are in themselves though they are not conceived through themselves.[182] And this is how men commonly conceive of substances. He continues: substance is that whose concept does not need the concept of any other thing upon which it must rest. But there is also a difficulty in this, for he says in the next definition that an attribute is perceived by the understanding as belonging to substance and as constituting its essence. Therefore the concept of the attribute is necessary to form the concept of the substance. If you reply that an attribute is not a thing and that you merely mean that a substance does not need the concept of any other thing, I answer that it is then necessary to explain what "thing" means, in order to understand the definition and see why an attribute is not a thing.

Definition 4. It is also obscure to say that an attribute is that which the understanding perceives about substance as constituting its essence. For the question arises whether he understands by attribute every reciprocal predicate, or every essential predicate whether reciprocal or not, or, finally, every primary essential or indemonstrable predicate of substance.[183] See Definition 5.

Definition 5. A mode is that which is in something else and is conceived through something else. It seems therefore to differ from an attribute in this—that an attribute is indeed in a substance but is conceived through itself. And with the added explanation here the obscurity of Definition 4 disappears.

Definition 6. He says: I define God as the absolutely infinite being, or as the substance which consists of infinite attributes, each of which expresses an eternal and infinite essence. He ought to show that these two definitions are equipollent;[184] otherwise the one cannot be substituted for the other. They will be equipollent if it is shown that there is a plurality of attributes or predicates in the nature of things which are conceived through themselves; but also that the several predicates are compatible with each other. Besides, every definition is imperfect, however true and clear it may be, which permits some doubt, even when it is understood, about whether the thing defined is possible. Now this is such a definition, for it still can be doubted whether a being having infinite attributes does not imply a contradiction. Furthermore, it can be doubted whether the same simple essence can be expressed through many different attributes. There are in fact many definitions of composite things, but only one of a simple thing, and its essence can be expressed, it seems, only in one way.[185]

Definition 7. A being is free which exists and is determined to action by the necessity of its own nature; a being is coerced whose existence and action are determined by another.

Definition 8. By eternity I mean existence itself insofar as it is conceived to follow from the essence of a thing. I approve of both of these definitions.

As for the axioms, I make the following comments. The first is obscure as long as what it means "to be in itself" is not stated. No comment is necessary on the second and the seventh. The sixth hardly seems consistent, for every idea agrees with that of which it is the idea, and I do not see what a false idea can be. I believe that the third, fourth, and fifth axioms can be proved.

Proposition 1. Substance is by nature prior to its affections, that is, to its modes, for he has said in Definition 5 that by the affections of a substance he means the modes. But he has not explained what the term "prior by nature" means, and so this proposition cannot be demonstrated from what precedes it. But it seems that by "something prior to another thing by nature" he means that through which the other thing is conceived. Yet I confess that I find some difficulty in this too, for it seems that what is posterior cannot only be conceived through what is prior, but also the prior through the posterior. "To be prior by nature" can be defined in this way, however: as that which can be conceived without the other being conceived, while the other thing cannot, on the contrary, be conceived without the concept of the former. But, to tell the truth, to be prior by nature is a little more general even than this. For example, the property of the number 10 to be 6 + 4 is posterior to that of being 6 + 3 + 1, because this latter property is closer to the first property of all; ten is 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1. Still it can be conceived without the second property, and, what is more, it can be proved without it. I add another example. In a triangle the property that the three internal angles equal two right angles is posterior in nature to the property that two internal angles are equal to the exterior angle of the third. Yet the former can be understood without the latter and, indeed, can be demonstrated without it, though not as easily.

Proposition 2. Two substances with different attributes have nothing in common. If by attributes he means predicates which are conceived through themselves, I grant the proposition, assuming that there are two substances *A* and *B* and that *c* is the attribute of substance *A* and *d* the attribute of substance *B*, or that *c* and *e* are all the attributes of substance *A*, and *d* and *f* all the attributes of substance *B*. But the case is different if these two substances have some attributes different and some in common, as when *c* and *d* are the attributes of *A*, and *d* and *f* the attributes of *B*. If he denies that this is possible, he must demonstrate its impossibility. Perhaps he would demonstrate the proposition, against this objection, as follows. Since *d* and *c* alike express the same essence (being attributes of the same substance *A*, by hypothesis), and *d* and *f* also express the same essence, for the same reason (being by hypothesis attributes of the same substance *B*), *c* and *f* must also. Hence it follows that *A* and *B* are the same substance, which is contrary to hypothesis, and it is therefore absurd that two distinct substances can have anything in common. I reply that I do not concede that there can be two attributes which are conceived through themselves and yet can express the same substance. For, whenever this happens, these two attributes expressing the same thing in different ways can be further analyzed, or at least one of them.[186] This I can easily prove.

Proposition 3. If two things have nothing in common, one cannot be the cause of the other, by Axioms 5 and 4.

Proposition 4. Two or more distinct things are distinguished either by the diversity of the attributes of their substances or by the diversity of affections. He proves this as follows. Everything that is, is either in itself or in something else, by Axiom 1; that is, outside of the understanding there is nothing besides substances and their affections, by Definitions 3 and 5. Here I am surprised at his forgetting attributes, for in Definition 5 he understands merely modes by the affections of substances. It follows either that he speaks ambiguously or that he does not include attributes among the things that exist outside the understanding, but merely substances and modes.[187] For the rest, he could have shown the proposition more easily by adding that things which can be conceived through their attributes or affections are necessarily known and therefore also distinguished from each other.

Proposition 5. In the nature of things there cannot be two or more substances with the same nature or attribute.

Here I point out that what is meant by "in the nature of things" seems obscure. Does he mean in the whole of existing things or in the region of ideas or of possible essences? Then it is not clear whether he meant to say that there are not many essences with the same common attribute or that there are not many individuals with the same essence. I also wonder why he here takes the word "nature" and the word "attribute" as equivalent, unless he means by attribute that which contains the whole nature. If this is assumed, I do not see how there can be many attributes of the same substance which are conceived through themselves.

His proof of the proposition is as follows. If the substances were distinct, they would be distinguished either by affections or by attributes; if by affections, then, since a substance is by nature prior to its affections, by Proposition 1, they must also be distinguished apart from their affections, and therefore they are distinguished by their attributes. If by their attributes, then there are no two substances with the same attribute. I reply that there seems to be a concealed fallacy here. For two substances can be distinguished by their attributes and still have some common attribute, provided they also have others peculiar to themselves in addition. For example, A may have the attributes c and d, and B the attributes d and e. I note further that Proposition 1 is useless except for proving this proposition. It might have been omitted, for it is enough that substance can be conceived without its affections, whether it be prior to them by nature or not.

Proposition 6. One substance cannot be produced by another substance. For, by Proposition 5, two substances do not have the same attribute; therefore, they can have nothing in common, by Proposition 2, and therefore the one cannot be the cause of the other, by Axiom 5. To prove the same thing otherwise and more briefly: What is conceived through itself cannot be conceived through something else as its cause, by Axiom 4. For the rest, I grant the demonstration if substance be taken as something which is conceived through itself. The case is different if substance is taken to be something which is in itself, as this is commonly understood, unless he shows that to be in itself and to be conceived through itself are the same thing.

Proposition 7. To exist pertains to the nature of substance. One substance cannot be produced by another, by Proposition 6. Therefore it is the cause of itself, that is, by Definition 1, its essence involves existence. Here he is rightly to be criticized for using the term "cause of itself" sometimes in the special sense which he has given it in Definition 1 and sometimes in its common and popular meaning. Yet it is easy to remedy this, if he transforms Definition 1 into an axiom and says: Whatever is not from something else is from itself, or from its own essence. But then there remain other difficulties here. For the reasoning is valid only on the assumption that substance can exist. For, since it cannot be produced by something else, it must exist by itself, and hence exist necessarily. But it must be demonstrated that substance is possible, that is, that it can be conceived. This, I think, can be demonstrated: for, if nothing can be conceived through itself, nothing will be conceivable through something else either, and therefore nothing will be conceivable at all. To show this more distinctly, we must consider that, if *a* is assumed to be conceived through *b*, the concept of *b* must be contained in the concept of *a*. And, again, if *b* is conceived through *c*, the concept of *c* must be contained in the concept of *b*, and thus the concept of *c* will be contained in the concept of *a*; and so on, to the last concept. If someone answers that there is no last concept, I reply that then there is no first one either, and I prove it as follows. Since there is nothing except alien elements in the concept of that which is conceived through something else, then proceeding by stages through many concepts, it will have either nothing whatever in it or nothing except what is conceived through itself. I believe that, although this demonstration is new, it is infallible. With its aid it can be proved that what is conceived through itself is possible. Yet we can still doubt whether it is possible in the sense in which it is here assumed to be possible, namely, not merely for that which is conceivable, but for that of which some cause can be conceived which is eventually reducible to a first cause. For not everything which is conceivable by us can therefore be produced, because of other more important things with which it may be incompatible. Thus, to prove that a being conceived through itself actually exists, we must resort to experience, because, since things exist which are conceived through other things, a thing exists through which they are conceived. So you see that an entirely different kind of reasoning is necessary to prove accurately that there is a thing which exists through itself.[188] But perhaps there is no need of this extreme caution.

Proposition 8. Every substance is necessarily infinite, because otherwise it would be limited by another substance of the same nature, by Definition 2, and there would be two substances of the same nature, which contradicts Proposition 5. This proposition must be understood as follows. A thing which is conceived through itself is infinite within its own kind; this must be admitted. But the demonstration suffers from obscurity as to the term "to be limited" and also from uncertainty, by reason of Proposition 5. In the scholium he gives an elegant proof that there is only one thing that is conceived through itself (within its own kind, that is), because, assuming that there is a plurality of individuals, there must be some reason in nature why there should be just so many and no more. But the reason for there being exactly so many is the same as that for there being this one and that one, and therefore the same as the reason for there being this particular one. But this reason is not to be found in one of them rather than another; therefore the reason is outside all of them. One objection is possible, namely, that the number of individuals is unlimited or no number at all, or that it exceeds any number. But this could be avoided if we take only some of them and ask why these exist, or if we take several of them having a common property, such as existence in the same place, and ask why they exist in this place.

Proposition 9. The more reality or being a thing possesses, the more attributes belong to it. (He should have explained what is meant by reality or being, for these terms are subject to equivocation.) His demonstration: it follows from Definition 4. Thus our author. But it does not seem to me to follow from it. For one thing can have more reality than another for the reason that it is greater in its own kind or has a greater share in some attribute. For example, the circle has more extension than the inscribed square. And it can still be doubted that several attributes may belong to the same substance, in the sense in which the author understands attributes. Meanwhile I admit that, if his meaning of attributes is accepted and attributes are supposed to be compatible, a substance is the more perfect, the more attributes it has.

Proposition 10. Each attribute of the same substance must be conceived through itself, by Definitions 4 and 3. But then it follows, as I have several times objected, that one substance can have only one attribute if this attribute expresses its whole essence.

Proposition 11. God, or the substance which consists of infinite attributes, each of which expresses an eternal and infinite essence, necessarily exists. He gives three demonstrations. First, because God is a substance and therefore exists, by Proposition 7. But this assumes that a substance necessarily exists, which was not sufficiently proved in Proposition 7, and that God is a possible substance, which is not so easy to prove. The second proof is that there must always be a cause for the being of a thing as well as for its nonbeing. But there can be no reason why God should not exist—not in his own nature, for this implies no contradiction; not in anything else, for that something else would either be of the same nature and attribute, and therefore would be God, or it would not, in which case it would have nothing in common with God and so could neither support nor prevent his existence. To this I reply (1) that he has not yet proved that God's nature does not imply contradiction, even though the author says without proof that it is absurd to say that it does, and (2) that another being could have the same nature as God in some things but not in all. His third argument: finite beings exist, by experience. Therefore, if an infinite being did not exist, the finite beings would be more potent than the infinite being. To this I reply: If the infinite being implies a contradiction, it will have no power at all; not to mention that the capacity to exist cannot properly be called a power.

Propositions 12 and 13. No attribute of substance can truly be conceived from which it would follow that substance is divisible; or, taken absolutely, substance is indivisible. For it will be destroyed by division; the parts will not be infinite and therefore not substances. Or else there would be several substances of the same nature. I grant this argument for a thing existing through itself.

Hence the corollary follows that no substance is divisible, and therefore the corporeal substance, too, is indivisible.

Proposition 14. There is no substance besides God, and none can be conceived. Because all attributes pertain to God and there is no plurality of substances with the same attribute, there are no substances besides God. All this presupposes the definition of substance as a being which is conceived through itself, as well as many other propositions, already noted, which cannot be granted. (It does not yet seem certain to me that bodies are substances; with minds the case is different.)

Corollary 1. There is only one God.

Corollary 2. Thinking being and extended being are either attributes of God or, by Axiom 1, affections of the attributes of God. Here he speaks confusedly; besides he has not yet shown that extension and thought are attributes or can be conceived through themselves.

Proposition 15. Whatever is, is in God, and nothing exists or can be conceived without God. For since there is no substance besides God, by Proposition 14, all other things are affections or modes of God, because there is nothing besides substances and modes. (Again he omits attributes.)

Proposition 16. From the necessity of the divine nature there must follow an infinite number of things in infinite modes, that is, everything which can be an object of an infinite intellect, by Definition 6.

Corollary 1. Hence it follows that God is the efficient cause of everything which is the object of his intellect.

Corollary 2. God is a cause through himself and not by accident.

Corollary 3. God is absolutely the first cause.

Proposition 17. God acts solely according to the laws of his own nature and is coerced by no one, since there is nothing outside of him.

Corollary 1. Hence it follows, first, that there is no cause which moves God to act, either extrinsically or intrinsically, except the perfection of his own nature.

Corollary 2. Only God is a free cause.

In the scholia he explains in more detail that God has created everything which is in his intellect (though it would seem that he has created only what he wills). He also says that the intellect of God differs in essence from our intellect and that the name "intellect" can be ascribed to both only equivocally, like calling both the heavenly constellation and a barking animal a dog. The thing caused differs from its cause in that which it receives from its cause. One man differs from another with respect to the existence which he receives from him; he differs from God with respect to the essence which he receives from God.

Proposition 18. God is the immanent, not the transeunt, cause of all things. This follows from the proposition which he thinks he has proved above, namely, that only God is a substance, and all the rest his modes.

Proposition 19. God or all his attributes are eternal. For his essence involves existence, and his attributes involve his essence. In addition, the author refers to the proof given in Proposition 19 of his work on the Principles of Descartes and approves of the way he demonstrated it.[189]

Proposition 20. The essence and the existence of God are one and the same thing. He proves this as follows: all that can be attributed to God belongs to his essence; all his attributes are eternal (Proposition 19) and therefore express existence (by the definition of eternity). But the same attributes also express essence, by the definition of attributes. Therefore essence and existence are the same in God. I reply that this does not follow but only that essence and existence are expressed by the same thing. I note also that this proposition presupposes the preceding one; if, therefore, the demonstration of the preceding proposition were applied instead of the proposition itself to the demonstration of the present one, an awkward circle would become apparent, as follows. I prove that God's essence and existence are one and the same, because the attributes of God express both essence and existence. They express essence by the definition of an attribute, and they express existence because they are eternal. But they are eternal because they involve existence, since they express the essence of God, which involves existence. What need, then, of mentioning the eternity of attributes and Proposition 19, since the matter reduces to nothing more than a proof that the existence and essence of God are one and the same thing, because the essence of God involves existence. All the rest is introduced as an empty pretentious device to twist the whole into the form of a demonstration. Reasoning of this kind is very common among men who do not know the true art of demonstration.

Corollary 1. Hence it follows that God's existence, as well as his essence, is an eternal truth. I do not see how this proposition follows from the preceding one; in fact, it is far more true and clear than the preceding. For it becomes evident at once, if we assume that God's essence involves existence, even if essence and existence are not admitted to be one and the same.

Corollary 2. God and all his attributes are immutable. The author's statement and proof of this are both obscure and confused.

Proposition 21. All that follows from the absolute nature of some attribute of God must exist always and be infinite or is eternal and infinite through this same attribute. He demonstrates this obscurely and at length, though it is easy.

Proposition 22. Whatever follows from some attribute of God, inasmuch as it is modified by such a modification as exists necessarily and is eternal through this attribute, must also exist necessarily and be infinite. He says the demonstration proceeds as in the preceding. So it too is obscure. I wish he had given an example of such a modification.

Proposition 23. Every mode which exists necessarily and is infinite must follow necessarily either from the absolute nature of some attribute of God or from some attribute modified by a mode which exists necessarily and is infinite. That is, such a mode follows from the absolute nature of some attribute, either immediately or by the mediation of some other such mode.

Proposition 24. The essence of the things produced by God does not involve existence, for otherwise they would be the causes of themselves, by Definition 1, which is contrary to hypothesis. This proposition is obvious on other grounds, but this demonstration is fallacious. For in Definition 1, "being the cause of itself" has taken on a particular sense which is not its common meaning. The author therefore cannot substitute the common meaning of the word in place of his own arbitrary meaning without showing that the two are equivalent.[190]

Proposition 25. God is the efficient cause not only of the existence of things but of their essence as well. Otherwise the essence of things could be conceived without God, by Axiom 4. But this proof carries no weight. For even admitting that the essence of things cannot be conceived without God, by Proposition 15, it would not follow that God is the cause of their essence. For the fourth axiom does not say that "the cause of a thing is that without which it cannot be conceived." (This would be false, for a circle cannot be conceived without a center, or a line without a point, yet the center is not the cause of the circle, nor the point of the line.) The fourth axiom says merely that "the knowledge of the effect involves the knowledge of the cause," which is something far different. Nor is this axiom convertible—not to mention the fact that to involve something is one thing and to be inconceivable without it is another. The knowledge of a parabola involves the knowledge of its focus, yet the parabola can be conceived without it.

Corollary. Particular things are nothing but the affections or modes of the attributes of God, which express these attributes in a definite and determinate way. He says this is evident from Definition 5 and Proposition 15, but the connection between this corollary and the present Proposition 25 is not clear. Spinoza is certainly not a great master of the art of demonstrating. This corollary is evident enough from what was said above, but it is true only if it is understood in the right sense; that is, in the sense not that things are such modes but that the ways in which we conceive particular things are determinate ways of conceiving the divine attributes.[191]

Proposition 28. Any individual thing, or anything which is finite and has a determinate existence, cannot exist or be determined to act unless it is determined to exist and to act by some other cause which is also finite and has a determinate existence, and this in turn by another, and so on to infinity. For nothing limited, finite, and existing in a definite time can follow from the absolute essence of God. Rightly understood, this opinion leads to many absurdities. According to it, things would not truly follow from the nature of God. For the determining thing is in its turn determined by another thing, and so on to infinity; thus things are in no way determined by God. God merely contributes something absolute and general of his own. It would be more correct to say that one particular thing is not determined by another in an infinite progression, for in that case things would always remain indeterminate, no matter how far you carry the progression. All particular things are rather determined by God.[192] Prior things are not the full cause of the posterior,[193] but God rather creates posterior things so that they are connected with the prior according to certain rules of wisdom. If we say that prior things are the efficient causes of posterior, the posterior will in turn be the final causes of the prior, in the opinion of those who hold that God operates according to purposes.

Proposition 29. There is nothing contingent in the nature of things, but everything is determined to a certain way of existence and action by the necessity of the divine nature. The demonstration is obscure and abrupt, being carried through by means of the abrupt, obscure, and questionable propositions which have preceded it. The matter depends on the definition of "contingent," which he has given nowhere. I use the term "contingent," as do others, for that whose essence does not involve existence. In this sense particular things are contingent according to Spinoza himself, by

Proposition 24. But if you take contingent in the sense of some of the Scholastics, a usage unknown to Aristotle and to common life, as that which happens in such a way that no reason of any kind can be given why it should have happened thus rather than otherwise, and as that whose cause is equally disposed to act and not to act when all the conditions, both internal and external, have been fulfilled, then I think that such contingency implies a contradiction; for, according to the hypotheses of a divine will and a given state of things, everything is defined and determined by its own nature, even though this nature may be unknown to us and is determined not by itself but, according to the supposition or hypothesis, by the external conditions.

Proposition 30. Both the actually finite intellect and the actually infinite intellect must comprehend the attributes of God and the affections of God and nothing else. This proposition, which is clear enough from the preceding, and true if taken in the right sense, our author proves in another obscure, questionable, and devious way, as is his wont. He says, namely, that a true idea must agree with its object; that is, as is self-evident (so he says, though I am unable to understand why it is self-evident or even true), that what is contained in the intellect as its object must necessarily exist in nature but that there is only one substance in nature, namely, God. These propositions, however, are obscure, questionable, and far-fetched. Our author's mind seems to have been most tortuous; he rarely proceeds by a clear and natural route but always advances in disconnected and circuitous steps, and most of his demonstrations surprise the mind instead of enlightening it.

Proposition 31. The intellect, whether actually finite or infinite, along with the will, desire, love, etc., must be ascribed to the natura naturata and not to the natura naturans. By natura naturans he means God and his absolute attributes; by natura naturata, his modes. But he regards intellect as nothing but a certain mode of thinking. Hence he says elsewhere that, strictly speaking, God has neither intellect nor will. I do not agree with this.

Proposition 32. Will cannot be called a free cause but only a necessary one, because only that which is determined by itself is free. But will is a mode of thought and is therefore determined by something other than itself.

Proposition 33. The world could not have been produced by God in any other way than it has been produced, for it follows from the immutable nature of God. This proposition may be true or false, depending on how it is explained. On the hypothesis that the divine will chooses the best or works in the most perfect way, certainly only this world could have been produced; but, if the nature of the world is considered in itself, a different world could have been produced. Thus we say that confirmed angels cannot sin, in spite of their freedom. They could if they willed, but they do not will. Speaking absolutely, they can will to sin, but in this existing state of things they no longer can so will. In his scholium the author rightly recognizes that something may be rendered impossible for two different reasons—either because it implies contradiction or because there is no external cause apt to produce it. He denies, in his second scholium, that God does all things in view of the good. He has already denied God a will, it is true, and he thinks that those who disagree make God subject to fate, though he himself admits that God does all things according to the principle of perfection.

Proposition 34. The power of God is his essence itself, because it follows from his essence that he is the cause of himself and of the other things.

Proposition 35. Whatever is in God's power exists necessarily, that is, it follows from his essence.[194]

Proposition 36. Nothing exists from whose nature some effect does not follow, because it expresses the nature of God, that is, his power, in a certain and determined way, by Proposition 34. This proposition does not follow, but it is nonetheless true.

He adds an appendix in which he attacks those who believe that God acts according to purposes. The appendix is a mixture of truth and falsehood. Even though it is true that not everything happens for the sake of men, it does not follow that God acts without will or knowledge of the good.

21

WHAT IS AN IDEA?

1678

In the marginal notes in his copy of Spinoza's Ethics, to Definition 4 of Part II, Leibniz commented: "explicatum ergo est, quid sit vera idea." An earlier answer to the question had been given in his early theological and legal writings (Nos. 5 and 6, II) and in his comments on criticisms of Malebranche (No. 11, II). But his earlier theory was metaphysical and needed to be related to the epistemological questions which were now foremost in philosophical discussion. This Leibniz did in his theory of expression or representation, for which his criticism of Spinoza prepared the way and which was clearly stated, with both epistemological and methodological applications, in this short paper from the same year.

* * *

[G., VII, 263-64]

First of all, by the term idea we understand something which is in our mind. Traces impressed on the brain are therefore not ideas, for I take it as certain that the mind is something other than the brain or a more subtle part of the brain substance.

There are many things in our mind, however, which we know are not ideas, though they would not occur without ideas—for example, thoughts, perceptions, and affections. In my opinion, namely, an idea consists, not in some act, but in the faculty of thinking, and we are said to have an idea of a thing even if we do not think of it, if only, on a given occasion, we can think of it.

Yet there is one difficulty in this view, for we have a "remote" faculty for thinking of all things, even those of which we may, perhaps, not have ideas, because we have the faculty of receiving ideas of them. Idea therefore requires a *certain "near" faculty or ability to think about a thing.*[195]

This does not quite suffice, however, for he who has a method which will lead him to some object if he follows it does not therefore have an idea of the object. So if I enumerate the conic sections in order, I shall certainly come to the knowledge of the opposite branches of the hyperbola, even though I do not yet have an idea of them. Hence there must be something in me *which not merely leads me to the thing but also expresses it*.

That is said to express a thing in which there are relations [*habitudines*] which correspond to the relations of the thing expressed. But there are various kinds of expression; for example, the model of a machine expresses the machine itself, the projective delineation on a plane expresses a solid, speech expresses thoughts and truths, characters express numbers, and an algebraic equation expresses a circle or some other figure. What is common to all these expressions is that we can pass from a consideration of the relations in the expression to a knowledge of the corresponding properties of the thing expressed. Hence it is clearly not necessary for that which expresses to be similar to the thing expressed, if only a certain analogy is maintained between the relations.

It is also clear that some expressions have a basis in nature, while others are arbitrary, at least in part, such as the expressions which consist of words or characters. Those which are founded in nature either require some similarity, such as that between a large and a small circle or that between a geographic region and a map of the region, or require some connection such as that between a circle and the ellipse which represents it optically, since any point whatever on the ellipse corresponds to some point on the circle according to a definite law. Indeed, a circle would be poorly represented by any other figure more similar to it in such a case. Similarly every entire effect represents the whole cause, for I can always pass from the knowledge of such an effect to a knowledge of its cause. So, too, the deeds of each one represent his mind, and in a way the world itself represents God. It may also happen that the effects which arise from the same cause express each other mutually, as, for example, gesture and speech. So deaf people understand speakers, not by sound, but by the motion of the mouth.

That the ideas of things are in us means therefore nothing but that God, the creator alike of the things and of the mind, has impressed a power of thinking upon the mind so that it can by its own operations produce ideas which correspond perfectly to what follows from the nature of the things. Although, therefore, the idea of a circle is not similar to the circle, truths can be derived from it which would be confirmed beyond doubt by investigating a real circle.

22

Letters to Nicolas Malebranche

1679

(Selections)

The acquaintance between Leibniz and Nicolas Malebranche, member of the Oratory and distinguished Cartesian and Platonist, began in Paris around 1675; the first volume of the Recherche de la vérité (1674) had then evoked both criticism and qualified defense by Leibniz (cf. No. 11, II). Their early correspondence had been concerned with the Cartesian theory of body and extension, which Leibniz was already criticizing. On receiving a copy of Malebranche's Conversations chrétiennes, published in 1677, from the Princess Elizabeth, Countess Palatine and sister of the Duchess Sophia of Hanover, Leibniz seized the opportunity to revive the correspondence. Letters between the two men continued intermittently until 1711. Many personal references and items of current intellectual gossip have been omitted in these translations.

* * *

I

[G., I, 327-28]

Hanover, January 13/23, 1679

. . . Through the favor of her highness, the Princess Elizabeth, who is celebrated as much for her learning as for her birth, I have been able to see your Christian Conversations.[196] Her judgment on it is very favorable, and, indeed, it contains many things that are very penetrating and very sound. I have grasped your opinion better through it than I had done in the past in reading the Recherche de la vérité, because I did not have enough leisure then. I wish you had not written solely for Cartesians, as you say you have done, for all sectarian labels should be odious, it seems to me, to a lover of the truth. Descartes has said some fine things; his was a most penetrating and judicious mind. But it is impossible to do everything at once, and he has given us only some beautiful beginnings, without getting to the bottom of things. It seems to me that he is still far from the true analysis and the general art of discovery. For I am convinced that his mechanics is full of errors, that his physics goes too fast, that his geometry is too narrow, and that his metaphysics is all these things together.

As for his metaphysics, you yourself have shown its imperfection, and I am entirely of your opinion concerning the impossibility of conceiving that a substance which has nothing but extension, without thought, can act upon a substance which has nothing but thought, without extension. But I believe that you have gone only halfway and that still other consequences can be drawn than those which you have made. In my opinion it follows that matter is something different from mere extension, and I believe, besides, that this can be demonstrated.

I agree with you completely when you say that God acts in the most perfect manner possible.[197] And when you say in one particular passage that "it is perhaps a contradiction that man should be more perfect than he is in relation to the bodies which surround him," you have only to strike out the perhaps. I find also that you make a most beautiful use of final causes; I have had a bad opinion of Mr. Descartes for rejecting them and also for certain other passages of his in which the depths of his soul seem to be exposed.

I beg you to commend me to Mr. Arnauld when you have occasion and to bear him witness that I shall honor his virtue and his equally incomparable learning all my life.

I should like to know whether your Mr. Prestet continues his work in analysis.[198] I hope so, for he seems fitted for it. I recognize more and more the imperfection of what we now have. For example, it gives us no way to solve the problems of Diophantine arithmetic; it can provide no method of inverse tangents, that is, of finding the curve from the given property of its tangent; it supplies no way of extracting the irrational roots of equations of higher degree; it is far removed from quadrature problems. In short, I could write a scholarly work on what it has not done and on what no Cartesian, whoever he may be, can succeed in doing without discovering some method which goes further than that of Descartes.

If I have the leisure, I hope some day to show, by some effective evidence, how far Descartes was from giving us the foundations of the true method. And not to mention other matters, it will then be seen that we are already able to take a bigger step beyond his own geometry than his takes beyond the geometry of the ancients.

Though I do not agree with all your opinions, I nevertheless find so many excellent thoughts in your works that I hope you will continue to produce them for us.

II

[G., I, 330-31]

June 22/ July 2, 1679

I have received your letter, for which I am obliged to you.[199] Shortly afterward I also received the Meditations on Metaphysics, which I can also attribute only to you, or at least to this Abbé Catelan to whom you ascribe the Christian Conversations.[200] He must be an able man and completely familiar with your opinions. I have read these Meditations, not as one reads an ordinary book, but carefully, and, if you will permit my frankness, I shall tell you what ideas I have formed about them. I approve most heartily these two propositions which you advance: that we see all things in God and that, strictly speaking, bodies do not act upon us. I have always been convinced of this for important reasons which seem to me indisputable and which rest on certain axioms which I do not as yet see used anywhere, though they could be most serviceable in proving some other theses no less important than those I have just mentioned.

As for the existence and nature of what we call body, we deceive ourselves even more than you say, and I agree with you that it would be hard to prove that there is extension outside of us in the sense in which this is usually understood. But, as for other spirits than ourselves, their existence can be demonstrated, and there must be more of them than is commonly believed. There is little difficulty concerning the perpetuity of all these spirits once they exist, but there is much difficulty concerning their beginning as this is commonly imagined.

I find very true, also, what you say about the simplicity of God's decrees being the cause of the existence of certain particular evils, since God would otherwise be obliged to change the laws of nature at each moment. But something more must be said about this, and I remember once having shown a little dialogue to Mr. Arnauld and Mr. des Billettes which went much further and left no more doubt about freedom, in my opinion, unless one adopts an absurd and contradictory notion of it. Whatever acts is free insofar as it acts. We must also say that God makes the maximum of things he can, and what obliges him to seek simple laws is precisely the necessity to find place for as many things as can be put together; if he made use of other laws, it would be like trying to make a building with round stones, which make us lose more space than they occupy.

As for the soul of beasts, I believe that you would judge quite differently from Descartes about them if you were to regard your own positions from the same point of view as I do, who am convinced of them, but for reasons which differ from yours. The reasons which you give in your Meditations do not seem convincing enough and do not lead where they should. I do not say this out of vanity or a spirit of contradiction, but I hold the remark to be necessary. For long experience has shown me that our thoughts are confused as long as we do not have rigorous demonstrations. This, I think, is why we can reason a little more loosely in mathematics, where matters are self-regulating, but that we should reason with greater rigor in metaphysics, because we lack the aid of imagination and experience there and because the slightest lapse in that field produces bad effects which it is hard to notice.

I believe the fact that you approve in Mr. Descartes what I am unable to appreciate results from our not understanding each other well. I consider it certain that the proofs which he produces for the existence of God are imperfect as long as he does not prove that we have an idea of God or of the greatest of all beings. You may reply that, if we did not, we could not reason about him. But one can also reason about the greatest of all numbers, an idea which nevertheless implies a contradiction, as does also the greatest of all velocities. This is why we still need much deep meditation to complete this demonstration. Someone may say: I conceive the most perfect of all beings because I conceive my own imperfection and that of the other imperfect beings, though they may be more perfect than I, and I would not know this without knowing what an absolutely perfect being is. But this is still not sufficiently convincing, for I can judge that two is not an infinitely perfect number, because I have, or can perceive in my mind, the idea of another number more perfect than it, and still another more perfect than this. Yet, after all, I still do not get from this any idea of an infinite number, though I see very well that I can always find a number greater than any given number whatever.[201]

The distinction between soul and body is not yet entirely proved. For, since you admit that we do not conceive distinctly what thought is, it is not enough that we are able to doubt the existence of extension (that is, of the extension which we conceive distinctly) without being able to doubt thought. This, I say, is not enough to draw a conclusion as to how far the distinction can be carried between what is extended and what thinks, since it can be said that perhaps it is only our ignorance which distinguishes them and that, in some way unknown to us, thought includes extension.

Nevertheless, I am convinced of all these aforesaid truths, in spite of the imperfection of their ordinary proofs, instead of which I think I can give rigorous demonstrations. Since I began to meditate when I was not yet imbued with Cartesian opinions, I penetrated into the nature of things by another door and discovered new lands. So strangers making a tour of France who follow the paths of those who have preceded them never experience anything unusual unless they are very careful or very lucky, while those who take the side roads, even at the risk of getting lost, are more likely to meet with things which other travelers do not know.

You have delighted me with your information that Mr. Arnauld is perfectly restored to health. God grant that he may enjoy it a long time still, for where should we find a person like him? I beg you to assure him of my respect.[202] . . .

23

Two Dialogues on Religion

Ca. 1678
(Selections)

There are many evidences of a heightened interest in religion during the first years which Leibniz spent at Hanover; among them are four dialogues on religion written around 1678. Parts of two of these are here translated. The first is satirical in mood and contrasts the true love of God with ecclesiastical fashions and superstitions. It may be considered as the literary account of discussions between Leibniz himself and Nicolas Steno, apostolic vicar at Hanover at that time.[203] The second, without title, but with a marginal note saying, "Written before the death of Duke John Frederick," ends in a mood of deep exaltation. It describes the moral effects of the religious faith which Leibniz's work was to establish (cf. No. 28). Both dialogues are taken from Jean Baruzi's incomplete copies in "Trois dialogues mystiques inédits de Leibniz," Revue de métaphysique et de morale, XIII (1905), 1-38.

* * *

I

DIALOGUE BETWEEN POLIANDER AND THEOPHILE

Some months ago I found myself in the same coach with an apostolic missionary and a very honorable man [homme honnête] of the Augsburg Confession who had had important duties at the court but had retired from the world to look after his salvation. The missionary was named Poliander. He had grown old in controversy and had no hesitation in starting in on people on this subject. So he at once attached himself to Theophile (this was the gentleman's name), seeing him in a humor to listen peaceably. Poliander deployed all his rhetoric and made use of the devices customary to those of his kind. Theophile defended himself with a certain self-effacement and simplicity which gave ample evidence of great resources and an enlightened and tranquil soul. The discussion had already lasted a whole morning, and they had got no further than ever, when Theophile, taking the lead with the purpose of changing the conversation a little, began as follows.

Th. I am surprised that people are more strongly attached to these disputes than to the practice of piety, Poliander. You agree that those who love God above all things are in the state of salvation. Why is it necessary to entangle one's self further in so many difficult problems? What end is gained?

Po. It is not enough to love God; it is necessary to obey his wishes, that is to say, the church which interprets them.

Th. Whoever truly loves God above all things will not fail to do what he knows to conform to his commands. This is why it is necessary to begin with this love, since charity and justice are its inescapable results.

Po. A pagan philosopher can love God above all things, since his reason can teach him that God is an infinitely perfect and a supremely lovable being. But this will not make him a Christian, for he may not have heard anything about Jesus Christ, without whom there is no salvation. So the love of God is not enough.

Th. This question of the salvation of pagans is too much for me. However, I have much liking for the ideas of certain learned and pious theologians who believe that God will illumine all those who sincerely seek him, at least at the point of death, and will reveal to them, even internally, what it is necessary to know about Jesus Christ, following the incontestable rule that God does not deny his grace to those who do their part.

Po. I have no desire to fight opinions which seem quite fitting to reconcile piety with reason, and I should agree with you that the love of God above all things does suffice when the matter is understood in this way. But this love must necessarily be true, serious, sincere, ardent, and active. For we try to learn the wishes of the person whom we love and to conform to them. A true lover has regard for the slightest movements of the person on whom his happiness depends. And yet the rest of you believe you can dispense with learning the orders which God has made so very clear that no one can claim grounds for ignorance of them. There is nothing more clear and more conspicuous than his church, which may be seen afar off, like a city set upon a hill. Yet you close your eyes in order not to see it.

Th. I confess that it is necessary to learn the will of him whom one loves and honors, for the purpose of carrying it out. But since there is an order in everything, and one cannot respond equally to diverse concerns, I believe at the same time that we must begin our obedience with the first of his wishes, which is well enough known to us. Reason and Scripture both tell us that we must love God above all things and our neighbor as ourself. It even appears that this love suffices for salvation and that everything else is but a result, following what we have just said.

Po. I assume that God is truly loved; I now ask what he who loves God ought to do. And I maintain that the first concern we should have after the love of God is to search for the true church.

Th. Good enough. But the assumption that you make is a great one and very rare here below. What, Poliander! Do you really think that God is loved above all things? I maintain that few people know what the love of God is. . . .

Po. Perhaps the love of God is not as necessary as you think, and it suffices to fear him. For, according to our teaching, attrition, that is, penitence bestowed through fear of punishment, suffices, along with the sacrament of absolution, even though one does not love God above all things; that is, even though there is no contrition, for you know the difference which exists between these two kinds of penitence.[204]

Th. I am amazed that an opinion as dangerous as this is accepted among people who confess Christianity. The Jansenists show us its absurdity, the Holy Fathers and even the old Schoolmen are ignorant of it, and, since God has commanded us to love him above all things, it is very clear that whoever does not is in a state of mortal sin.

Po. Don't mention the Jansenists to me, Theophile. They are considered by Rome as heretics. As for the Fathers, we study them very little; in fact, we have done away with them, except for the many fine collections we have drawn from their writings, which serve us to combat you. This is the whole use we make of the Fathers. What is more, the ancients are eclipsed by the beautiful subtleties and unusual questions of the moderns. In a word, since the church is infallible, every opinion which is today publicly accepted in our chairs of theology cannot but be good, as is every practice publicly received and approved by our flood of doctors. The doctrine of attrition is one of this number, and we need seek no other proof of it.

Th. Yet there are men of piety and learning among you who speak of reform, who try to call you back to the simplicity of doctrine and the exactitude of discipline which was apparent in the primitive church.

Po. Such people are only visionaries or ambitious men who are scarcely better than heretics, since they have the presumption to reform the holy church. Can infants reform their mother? Nothing is more insupportable. But if you insist in wishing for reformers, we have a good number of them, but they take care not to give offense to the opinions received by the doctors.

Th. I see that you have no desire for reformers, if the matter is taken in a right sense, for the church and what it teaches and approves are for you beyond reform. What you would have are people who dote upon the mode,[205] and you call them reformers in the sense that they are the founders and renovators of religious orders.

Po. If you mean by "mode" what we call the accepted practice of the church in conformity with the century in which we live, this is true. For, since the church is infallible, it cannot but choose a mode which is fitting for the time. So when hermits are in vogue, we must conform to the Thebaid; when Scholastic theology reigns, we must quibble as much as possible; when casuists take their place, it is meritorious to be a casuist. For though the casuists may have been in error when they diminished the number of sins, this did not prevent their being useful, for men who believe that what they are doing is not sinful, are not as great sinners as when they know they are sinning. But if the casuists diminish the number of sins which are contrary to moral virtues, they compensate for this by leading men to the Christian virtues, that is, they teach them to have regard for sacred ceremonies and all sorts of religious observances accepted today, for we must push things as far as we can. This is why the true reformers are those who introduce certain fashions and modes of praying and of honoring God, such as rosaries, chaplets, scapulars, and a thousand other sacred inventions, for they teach people to conform to the mode which reigns in the church, which is the interpreter of God's will.

Th. But you make no mention of charity or justice, and I do not see many reformers who take up these things and still fewer who succeed with them in the minds of men of the times—perhaps because this is not the mode.

Po. Take good care not to confuse such purely moral reforms with Christian reforms. Justice and charity are things which we can have in common with pagans; it takes other pious practices to please God. That is, we need fastings, hair shirts, disciplines, gratings, books of hours, the Ave Maria, and similar things; as for the Lord's Prayer, I see nothing in it which a pagan cannot also say. This is why we make much more of a case for the Ave Maria.

Th. I might well agree with all that you have said, Poliander, if we assumed the infallibility of the practice which reigns in your church. But it seems to me that this pushes infallibility a little too far. Many able men among you, besides, recognize no other infallible Catholic doctrine than that coming from tradition. They give the church the right to witness, not to rule.[206] This being so, it is not necessary to hold to the practice which rules today but rather to that which the church received traditionally from Jesus Christ and the apostles. . . . But let us leave the court of Rome, with all its infallibility, since you have not proved it, and long discussion would be necessary to reach the end. Let us return to what is more certain. This is that we must love God above all things and our neighbor as ourselves. It is in this that the law consists; it is in this that true active faith also consists, in conformity to the teaching of Jesus Christ. For he has taught us this great secret; he has been not only the preceptor but also the redeemer of mankind. The divinity which dwells in the human nature of Jesus Christ has established reunion between God and men. There is no salvation at all except in Jesus Christ. . . . You call yourself an apostolic missionary, and we call ourselves evangelicals. Let us agree with the evangelist and apostle Saint John, who proclaimed nothing but this charity full of faith, and this divine love which enlightens through good deeds, and we shall have enough to save ourselves and to win souls.

Po. I have received no instruction from Rome about that. However, I approve your reasons in part, and I shall have a little more consideration for them in the future than I have in the past. But you, who have thought so well about the divine love, carry out your promise as well. You have agreed with me that the first thing which we should seek, after this love, is the true church. This is the true union of all the living members of Jesus Christ; in a word, it is the universal charity.

Th. If you put it on that basis, I am already one of you. But it seems to me that you demand something more, which I can hardly grant you. You wish us to be convinced of a great number of new and doubtful things and to condemn absolutely all who dare to doubt them. Besides, you are too ceremonious, and you engage souls with so many superfluous cares that they turn away from him who ought to be their chief care. All this hurts this universal charity, it seems to me. But here is the inn; we can speak more at our ease after we have refreshed ourselves a little from the fatigues of the journey.

II

Dialogue between Polidore and Theophile

Theophile. I have found you somewhat changed for some time, my dear Polidore, and it seems to me that your usual gaiety is lacking. Yet your affairs are prospering, your prudence has been helped by fortune, and you lack none of the things which men seek with such eagerness. You have wealth, you have acquired fame, and God has given you so vigorous a constitution that we may hope to enjoy you for many more years. So I cannot understand the cause of the change which I observe.

Polidore. I know that you love me, Theophile, and I esteem you enough to enlighten you. I will tell you, then, that what you see in me is not sadness but an indifference which I feel about many of the things which once appealed to me. Now that I have attained the things I wanted, I have come to recognize their vanity, and, finding myself at the peak of the joys to which men aspire here below, I recognize better than ever the imperfection of human nature, which is incapable of solid happiness. You know that gross lusts do not much move me, but a short time ago I found more and more that the most refined pleasures of the mind are only pleasing deceptions which disappear when closely examined. Is there anything on earth to which great spirits are more sensitive than glory and the immortality of name which we like to imagine? And yet what good will they do me when I am reduced to dust? These reasons will not keep me from doing things worthy of approbation, for it is my habit to do them, and I could hardly do otherwise, but I shall no longer exert myself to acquire so chimerical an immortality. My intellectual curiosity is thus diminished by half; I no longer enjoy the beauties of nature and of art; and I find even less satisfaction in beautiful discourses, for they often consist only in an outburst of well-arranged words. And though I recognize that there are solid sciences like mathematics and mechanics, I observe that these are of use only to those who make a profession of them, for they take too much work. Since we shall lose the fruits of all our labors in a moment, let us not embarrass ourselves with anything whatever but follow an easy path of life and arm ourselves with indifference against the deceptive charms of enterprise.

Th. I am sorry for you, Polidore, for I see that you are depriving yourself of the greatest satisfaction of life, just when you are in the best circumstances to enjoy it. But I am still more sorry for the public and for posterity, which will be deprived of the great and excellent things you planned at a time when your affairs did not permit you to carry them out. It makes me wonder at the conduct of men, who seek only what is far off. But I perceive only that you have changed your maxims, that you no longer believe that you are under obligation to trouble yourself for the public, and find it ridiculous to work for a time when you will no longer exist. Yet I believe that you would judge otherwise if you were convinced that there is a great monarch of the universe, who takes everything done for the public as done for himself; and that, if you were convinced of the immortality of our souls, then you would take an interest in the state of future centuries.

Po. If you are speaking to me as a theologian, I shall stop, for I submit to the faith. But if you are limiting yourself to philosophical boundaries, I see great reasons for doubting these beautiful things, which serve only to soften our misery by false hopes. I admit that I should like to be one of those who are happy through their errors, but, since I see clearly that they are errors, it no longer rests with me but to turn my eyes away.

Th. But you, who have such excellent knowledge and have so often admired the wisdom of nature, can you doubt a governing providence when you consider the machine of the universe, which moves with such regularity?

Po. It seems to me no great wonder that the sun, turning about its center, carries with it the liquid matter which surrounds it and is called ether and that this in turn also carries along some great balls called planets, which float in this ether and follow its motion with greater or less speed in proportion to their solidity and distance. And, since they meet with no resistance, we need not be astonished that their periods are regular, with no noticeable change for a long period of time.

Th. What you say is reasonable. Once assume the motion of this ether as well as the balls of different solidity and volume around the sun, and the rest follows mechanically. But tell me how it happens that there is a sun, ether, and planets. Could not the world have been made in an entirely different way? And who has made things this particular way? Assuming even the choice of these bodies explained, whence comes the principle of motion which we observe in them? . . .

[In a long discussion Theophile brings Polidore to assent at last to Leibniz's principle of the maximum compossible determination of existence, on the simplest assumptions.]

Th. See now if what we have just discovered ought not to be called God.

Po. The reasoning is excellent and sound, and I am most surprised. After this I will not wonder at the marvelous structure of organic bodies, the smallest part of which surpasses in craftsmanship all the machines which man can invent. But it seems that this wisdom, which reveals such economy in each animal or organic body considered separately, has left them afterward to attack each other in the greatest confusion imaginable. A wretched sheep is torn apart by a wolf, a pigeon falls prey to some vulture, the poor flies are exposed to the malice of spiders, and men themselves—what a tyranny they exercise over the other animals, and even among themselves they are more than wolves and more than vultures. What appearance of order is there in all this? Or, rather, since we have agreed on the sovereign wisdom of the Author of things, we must say that he cares not at all for what we call justice and that he takes pleasure in destruction as we take pleasure in hunting the beasts which prey on each other. Individuals must give way; there is room only for the species, some of which subsist through the misfortune of others. And we in our folly are presumptuous enough to imagine that he will exempt us from these universal cycles by means of an immortality which is without example in nature and is all the more incredible, since a beginning must be followed by an end.

Th. Your argument is plausible, and many persons of intelligence are unfortunately impressed by it, but, thank God, there is a way of meeting it. We have agreed that God made everything in the greatest perfection of which the universe is capable. Consequently each thing has in it, or will have, as much perfection as it is capable of claiming in proportion to what it already has, without doing violence to other things. But, since pleasure is nothing but the feeling of an increase of perfection, it follows that God will give all creatures as much pleasure as they are capable of, so that those who are reasonable find themselves as happy as possible, consistent with the harmony of the universe, which demands that when the books are balanced there must be found the greatest perfection and the greatest happiness possible in the whole. Perhaps this is impossible without the misery of some who deserve it.

Now, of all the creatures which surround us, it is only the spirit of man which is capable of a true happiness. It can be said that the difference between God and man is only one of more or less, though the ratio is infinite. Man demonstrates truths; he invents machines and is capable of containing within himself the perfections of the things whose ideas he conceives; he knows the great God, he honors him, he loves him, and he imitates him. He exercises dominion over some things with a detachment and an elevation like that of God, though his decisions meet with obstacles in their execution. One can say that, with regard to the perfection of spirit, there is at least as much difference between man and the other creatures in relation to God as there is between God and man. In short, there is some community between God and men. For since both are reasonable and have some commerce with each other, they compose a City which must be governed in the most perfect manner. This is why, if God is sovereign wisdom, as his admirable works show, and if wisdom seeks perfection everywhere insofar as it is possible, we cannot doubt that the most perfect beings, and those who most nearly approach God, are the ones most considered in nature, and that God is concerned for their happiness in preference to everything else. Finally, this is possible, and the order of the universe does not oppose it. It is true that our bodies are subject to the impact of other bodies and hence to dissolution. But the soul is a substance entirely different from matter and space and hence cannot be destroyed. And, since this is so, it is capable of subsisting and of being happy in spite of the destruction in the world. Provided that God leaves it memory and thoughts, the soul can be happy and unhappy, punished and rewarded, according to the laws of this City of which God is the monarch. . . .

Po. Your reasons are effective and permit no reply, and I admit that I am moved by them, all the more since you have most remarkably anticipated the objections of those who believe that all souls must be reunited to the soul of the universe, as the body is lost in the general mass. For, as you have well said, that which is once a body apart will always remain so and carry out its own functions in such a manner that it will be united with something else. Besides, this union of souls with the universal soul consists in a play on words only, which mean nothing, for souls are not like raindrops or brooklets which return to the ocean. If this comparison were good, it could still be said that each atom of the raindrop does not cease to subsist in the ocean as well and that souls as well never cease to have each its own thoughts when reunited to the universal soul of God. . . .

[In the following section Theophile gains Polidore's assent to the view that the will of God, the universal monarch, is reflected in the kingdom of spirits.]

Th. Since you have acknowledged this great point, let us draw its practical consequences. First, it follows that the world is governed in such a way that a wise person who is well informed will have nothing to find fault with and can find nothing more to desire. Second, every wise man ought to be content, not only out of necessity as if he were compelled to be patient, but with pleasure and a kind of extreme satisfaction, knowing that everything happens in such a way that the interests of each individual person who is persuaded of this truth will be achieved with every possible advantage. For when God admits us a little further into his secrets than he has until now, then, among other surprises, there will be that of seeing the wonderful inventions which he has used to make us happy beyond our possible conception. Third, we ought to love God above all things, since we find everything with greater perfection in him than in things themselves, and since his goodness provides us with our whole power. For it is by this goodness that we obtain everything we can wish for our happiness. Fourth, with these opinions we can be happy in advance here below, before enjoying everything which God has prepared for us; those who are discontent, on the other hand, expose themselves to losing voluntarily everything that God has tried to give them. It can be said that this resignation of our will to that of God, whom we have every reason to trust, follows from the truly divine love, whereas our dissatisfaction and even our disappointment in mundane matters contain something of hatred toward God, which is the ultimate of misery. Fifth, we ought to give witness of the supreme love which we bear toward God through the charity we owe to our neighbor. And we ought to make every effort imaginable to contribute something to the public good. For it is God who is the Lord; it is to him that the public good pertains as his own. And all that we do unto the least of these, his subjects, whom he has the goodness to treat as brothers, we have done unto him; all the more will he receive as brother whoever contributes to the general good. Sixth, we must try to perfect ourselves as much as we can, and especially the mind, which is properly what we call ourself. And, since perfection of mind consists in the knowledge of truth and the exercise of virtue, we should be persuaded that those who in this life have had the best entrance into eternal truths and the most transparent and clearest knowledge of God's perfection, and as a result have loved him more and witnessed with more ardor for the general good, will be susceptible of greater happiness in the life to come. For, finally, nothing is neglected in nature; nothing is lost with God; all our hairs are numbered, and not a glass of water will be forgotten; qui ad justitiam erudierunt multos fulgebunt quasi stellae;[207] no good action without reward, no evil one without some punishment; no perfection without a series of others unto infinity.

Po. Most truly beautiful and generous maxims! I see that they directly combat this indifference into which I should have plunged without your help. . . . You have restored me to life, my dear Theophile, for the sluggish and negligent life which I was about to lead was worth no more than death. Now my vigor returns; I shall go back to my plans. I see that virtue and glory are not chimeras. I recognize that the general lament about the misery of life poisons our satisfaction and strangely deceives us. Instead we must remember that we are the most perfect and happiest of all known creatures, or at least that it takes only us to become so. Felices nimium sua qui bona norint.[208] Hereafter let us no longer complain of nature; let us love this God who has so loved us, and know, once for all, that the knowledge of great truths, the exercise of divine love and charity, the efforts which one can make for the general good—by assuaging the ills of men, contributing to the happiness of life, advancing the sciences and arts and everything that serves to acquire a true glory and immortalize oneself through good deeds—all these are pathways to this felicity, which lead us as far as we are capable of going toward God and which we may take as a kind of apotheosis.[209]

24

On the General Characteristic

Ca. 1679

The year 1679 was one of the most creative in Leibniz's life and the last he was to enjoy under the patron who had called him to Hanover. In this year the detailed plans for two projects formulated much earlier were revived, and many studies written in preparation for their execution. These were the universal encyclopedia and the great apologetic work, the Catholic Demonstrations (No. 28).

For his encyclopedia as he planned it at this time, Leibniz chose the title Plus ultra (G., VII, 49-53), borrowed from Glanvill. Many of the preliminary drafts which Leibniz made for this work have been published in G., Volume VII, and in Cout. OF. The following selections (Nos. 24, 25, and 26) are arbitrary but give a conception of his plan and the state of his notions in logic. They may be regarded as belonging to the introductory section of the work, to be called "Initia et specimina scientiae generalis," Nos. 24 and 25 belonging to the "Initia" and Nos. 26 and 27 to the "Specimina."[210] The long lists of definitions on which Leibniz worked intermittently over a long period of time are not represented.

The following two selections are obviously closely related, the first discussing the origins and values of the general characteristic; the second, the general logical principles to be assumed as axiomatic in it.

* * *

I

[G., VII, 184-89]

There is an old saying that God created everything according to weight, measure, and number. But there are things which cannot be weighed, those namely which have no force or power. There are also things which have no parts and hence admit of no measure. But there is nothing which is not subordinate to number. Number is thus a basic metaphysical figure, as it were, and arithmetic is a kind of statics of the universe by which the powers of things are discovered.

Men have been convinced ever since Pythagoras that the deepest mysteries lie concealed in numbers. It is possible that Pythagoras brought over this opinion, like many others, from the Orient to Greece. But, because the true key to the mystery was unknown, more inquisitive minds fell into futilities and superstitions, from which there finally arose a kind of popular Cabbala, far removed from the true one, and that multitude of follies which is falsely called a kind of magic and with which books have been filled. Meanwhile there remained deep-rooted in men the propensity to believe that marvels can be discovered by means of numbers, characters, and a certain new language, which some called the Adamic language; Jacob Boehme called it the Natursprache.

But perhaps no mortal has yet seen into the true basis upon which everything can be assigned its characteristic number. For the most scholarly men have admitted that they did not understand what I said when I incidentally mentioned something of the sort to them.[211] And, although learned men have long since thought of some kind of language or universal characteristic by which all concepts and things can be put into beautiful order, and with whose help different nations might communicate their thoughts and each read in his own language what another has written in his,[212] yet no one has attempted a language or characteristic which includes at once both the arts of discovery and of judgment, that is, one whose signs or characters serve the same purpose that arithmetical signs serve for numbers, and algebraic signs for quantities taken abstractly. Yet it does seem that, since God has bestowed these two sciences on mankind, he has sought to notify us that a far greater secret lies hidden in our understanding, of which these are but the shadows.

Some unknown fate has brought it about, however, that when I was a mere boy I became involved in these considerations, and, as first inclinations usually do, they have remained strongly fixed in my mind ever since. Two things which are otherwise of doubtful merit, and are harmful to many people, proved wonderfully useful to me: first, I was self-taught, and, second, I looked for something new in every science when I first studied it, often before I even understood its already established content. But so I gained a double reward: first, I did not fill my head with empty and cumbersome teachings accepted on the authority of the teacher instead of sound arguments; second, I did not rest until I had traced back the tissues and roots of every teaching and had penetrated to its principles. By such training I was enabled to discover by my own effort everything with which I was concerned.

When I turned, therefore, from the reading of history, which had delighted me from my earliest youth, and from the cultivation of style, which I carried out with such ease both in prose and in more restricted forms that my teachers feared that I might remain stuck in such frivolities, and took up logic and philosophy and had barely begun to understand something about these fields, what a multitude of fancies came to birth in my brain and were scratched down on paper to be laid before my astonished teachers. Among other things I once raised a doubt concerning the categories. I said that, just as we have categories or classes of simple concepts, we ought also to have a new class of categories in which propositions, or complex terms themselves,[213] may be arranged in their natural order. For I had not even dreamed of demonstrations at that time and did not know that the geometricians do exactly what I was seeking when they arrange propositions in an order such that one is demonstrated from the other. My question was thus superfluous, but when my teachers failed to answer it, I pursued these ideas for the sake of their novelty, attempting to establish such categories for complex terms or propositions. Upon making the effort to study this more intently, I necessarily arrived at this remarkable thought, namely, that a kind of alphabet of human thoughts can be worked out and that everything can be discovered and judged by a comparison of the letters of this alphabet and an analysis of the words made from them. This discovery gave me great joy, though it was childish, of course, for I had not grasped the true importance of the matter. But, later, the more progress I made in my thinking about these things, the more confirmed I was in my decision to carry the problem further. It happened that as a young man of twenty I had to prepare an academic treatise. So I wrote a Dissertation on the Art of Combinations, which was published in book form in 1666, and in which I laid my remarkable discovery before the public. This dissertation was in fact such as might be written by a youth just out of the schools who was not yet conversant with the real sciences. For mathematics was not cultivated in those parts; if I had spent my childhood in Paris, as did Pascal, I might have advanced these sciences earlier. There are two reasons, however, why I do not regret having written this dissertation; first, it pleased many very gifted men greatly; and, second, in this dissertation I already then served notice to the public of my invention, so that it will not look as if I had thought of it only recently.

Why, within the memory of mankind as preserved by records, no mortal has ever essayed so great a thing—this has often been an object of wonder to me. For, to anyone who proceeds according to an order in thinking, these considerations should have occurred from the very first, just as they occurred to me as a boy interested in logic, before I had even touched on ethics, mathematics, or physics, solely because I always looked for first principles. The true reason for this straying from the portal of knowledge is, I believe, that principles usually seem dry and not very attractive and are therefore dismissed with a mere taste. Yet I am most surprised at the failure of three men to undertake so important a thing—Aristotle, Joachim Jung, and René Descartes. For when Aristotle wrote the Organon and the Metaphysics he laid open the inner nature of concepts with great skill. Joachim Jung of Lübeck is a man not well known even in Germany but of such rare judgment and breadth of mind that I cannot think of anyone, not even excepting Descartes himself, from whom a great revival of science might better have been expected, if only he had been known and supported.[214] He was already an old man, however, when Descartes began his activity, and it is regrettable that these men could not have known each other. As for Descartes, this is of course not the place to praise a man the magnitude of whose genius is elevated almost above all praise. He certainly began the true and right way through the ideas, and that which leads to this outcome; but later, after he began to aim his work too much at applause, he seems to have broken off the thread of his investigation into these matters and to have been content with metaphysical meditations and geometrical studies by which he could draw attention to himself. For the rest, he set out to discover the nature of bodies for the purposes of medicine. He would have accomplished this in the right way if he had completed the task of ordering the ideas of the mind, for a greater light than can well be imagined would have arisen from this project for his observations themselves. His failure to apply his mind to this problem can be explained by no other cause than that he did not adequately think through the full reason and importance of the matter. For had he seen a method of setting up a reasonable philosophy with the same unanswerable clarity as arithmetic, he would hardly have used any way other than this to establish a sect of followers, a thing which he so earnestly wanted. For by applying this method of philosophizing, a school would from its very beginning, and by the very nature of things, assert its supremacy in the realm of reason in a geometrical manner and could never perish nor be shaken until the sciences themselves die through the rise of a new barbarism among mankind.

As for me, I kept at this line of thought, in spite of the distraction of so many other fields, for no other reason than that I saw its entire magnitude and detected a remarkably easy way of following it through. For this is what I finally discovered after most intent thought. Nothing more is necessary to establish the characteristic which I am attempting, at least to a point sufficient to build the grammar of this wonderful language and a dictionary for the most frequent cases, or, what amounts to the same thing, nothing more is necessary to set up the characteristic numbers for all ideas than to develop a philosophical and mathematical "course of studies," as it is called, based on a certain new method which I can set forth, and containing nothing more difficult than other courses of study, or more remote from use and understanding, or more alien to the usual way of writing. Nor would it require more work than is already being spent on a number of courses, or encyclopedias, as they are called. I think that a few selected men could finish the matter in five years. It would take them only two, however, to work out, by an infallible calculus, the doctrines most useful for life, that is, those of morality and metaphysics.[215]

Once the characteristic numbers for most concepts have been set up, however, the human race will have a new kind of instrument which will increase the power of the mind much more than optical lenses strengthen the eyes and which will be as far superior to microscopes or telescopes as reason is superior to sight. The magnetic needle has brought no more help to sailors than this lodestar will bring to those who navigate the sea of experiments. What other consequences will eventually follow from it must be left to the decree of the fates; however, they cannot but be great and good. For men can be debased by all other gifts; only right reason can be nothing but wholesome. But reason will be right beyond all doubt only when it is everywhere as clear and certain as only arithmetic has been until now. Then there will be an end to that burdensome raising of objections by which one person now usually plagues another and which turns so many away from the desire to reason. When one person argues, namely, his opponent, instead of examining his argument, generally answers thus, "How do you know that your reason is any truer than mine? What criterion of truth have you?" And if the first person persists in his argument, his hearers lack the patience to examine it. For usually many other problems have to be investigated first, and this would be the work of several weeks, following the laws of thought accepted until now. And so, after much agitation, the emotions usually win out instead of reason, and we end the controversy by cutting the Gordian knot rather than untying it. This happens especially in deliberations pertaining to life, where a decision must be made; here it is given to few people to weigh the factors of expediency and inexpediency, which are often numerous on both sides, as in a balance. The more strongly we are able to present to ourselves, now one circumstance and now another, in order to balance the varying inclinations of our own minds, and the more eloquently and effectively we can adorn and point them out for others, the more firmly we shall act and carry the minds of other men with us, especially if we make wise use of their emotions. There is hardly anyone who could work out the entire table of pros and cons in any deliberation, that is, who could not only enumerate the expedient and inexpedient aspects but also weigh them rightly. Thus two disputants seem to me almost like two merchants who are in debt to each other for various items, but who are never willing to strike a balance; instead, each one advances his own various claims against the other, exaggerating the truth and magnitude of certain particular items. Their quarrel will never end on this basis. And we need not be surprised that this is what has happened until now in most controversies in which the matter is not clear, that is, is not reduced to numbers.

Now, however, our characteristic will reduce the whole to numbers, so that reasons can also be weighed, as if by a kind of statics. For probabilities, too, will be treated in this calculation and demonstration, since one can always estimate which of the given circumstances will more probably occur. Finally, anyone who is certainly convinced of the truth of religion and its consequences, and so embraces others in love that he desires the conversion of mankind, will surely admit, if he understands these matters, that nothing will be more influential than this discovery for the propagation of the faith, unless it be miracles, the holiness of an apostle, or the victories of a great monarch. Where this language can once be introduced by missionaries, the true religion, which is in complete agreement with reason, will be established, and apostasy will no more be feared in the future than would an apostasy of men from the arithmetic or geometry which they have once learned. So I repeat what I have often said: that no man who is not a prophet or a prince can ever undertake anything of greater good to mankind or more fitting for the divine glory.

But we must go further than words! Since the admirable connection of things makes it most difficult to give the characteristic numbers of a few things separated from others, I have thought of an elegant device, if I am not mistaken, by which to show that ratiocination can be proved through numbers. Thus I imagine that these most remarkable characteristic numbers are already given, and, having observed a certain general property to be true of them, I set up such numbers as are somehow consistent with this property, and, applying these, I at once demonstrate through numbers, in wonderful order, all the rules of logic and show how we can know whether certain arguments are in good form.[216] But the material soundness or truth of an argument can be judged without much mental effort and danger of error only when we have the true characteristic numbers of things themselves.

II

[G., VII, 299-301]

When I observed that almost all who think about principles follow the example of others rather than the nature of things, and even their prejudices when this is of great advantage, I concluded that it is not enough to avoid this error but that I should undertake some higher order with respect to my own opinions.

One cannot go to infinity in his proofs, however, and therefore some things must be assumed without proof—not silently and by stealth, indeed, dissimulating our own laziness as philosophers customarily do, but keeping clearly in mind what we have used as first assertions, after the example of geometricians who, to show their good faith, acknowledge at the very start the assumed axioms they are to use, so that they may be sure that all the conclusions are proved at least hypothetically from these assumptions.

First of all, I assume that every judgment (i.e., affirmation or negation) is either true or false and that, if the affirmation is true, the negation is false, and, if the negation is true, the affirmation is false; that what is denied to be true—truly, of course—is false, and what is denied to be false is true; that what is denied to be affirmed, or affirmed to be denied, is to be denied; and what is affirmed to be affirmed and denied to be denied is to be affirmed. Similarly, that it is false that what is false should be true or that what is true should be false; that it is true that what is true is true, and what is false, false. All these are usually included in one designation, the principle of contradiction.

Now we must see what can truly be affirmed and denied, so that its contradiction may also be known to be false. The first of the true propositions are those which are commonly called identical; such as A is A, non-A is non-A, and, if the proposition L is true, it follows that the proposition L is true. And however much useless "coccysm"[217] there seems to be in these judgments, they nevertheless give rise to useful axioms by a slight change. Thus, from the fact that A is A, or for example, that three-legged is three-legged, it is obvious that anything is as much as it is or is equal to itself. Hence (to show how useful identities are by an example) philosophers have long ago demonstrated that a part is less than the whole, by assuming only this definition: that is less which is equal to a part of another (the greater). The demonstration is as follows. A part is equal to a part of the whole (namely, to itself), by the axiom of identities. What is equal to a part of the whole is less than the whole, by the definition of less. Therefore a part is less than the whole, Q.E.D. Subalternation, or the derivation of a particular from a universal, may be proved similarly. All A is B; therefore some A is B, using a syllogism of the first figure. The derivation is as follows.

All A is B, by hypothesis.
Some A is A, by identity.
Therefore some A is B.

I offer these examples, though they do not belong here, to show that identities do indeed have a use and that no truth, however slight it may seem, is completely barren; on the contrary, it will soon be apparent that these identities contain the foundations of the rest.[218]

Just as identical propositions are the primary propositions of all, and are incapable of proof and thus true per se, for of course nothing can be found to serve as a middle term to connect something with itself, so, as a result, truths are virtually identical which can be reduced to formal or explicit identities through an analysis of their terms, if we substitute for the original term either an equivalent concept or a concept included in it. It is obvious that all necessary propositions, or propositions which have eternal truth, are virtual identities and can be demonstrated or reduced to primary truths by ideas or definitions alone, that is, by the analysis of terms, so that it is made clear that their opposite implies a contradiction and conflicts with some identity or primary truth. Hence the Scholastics also observed that truths which are absolute or have metaphysical necessity can be proved by their terms alone, since the opposite involves a contradiction.

In general, every true proposition which is not identical or true in itself can be proved a priori with the help of axioms or propositions that are true in themselves and with the help of definitions or ideas. For, no matter how often a predicate is truly affirmed of a subject, there must be some real connection between subject and predicate, such that in every proposition whatever, such as A is B (or B is truly predicated of A), it is true that B is contained in A, or its concept is in some way contained in the concept of A itself. And this must be either by absolute necessity, in propositions which contain eternal truth; or by a kind of certainty which depends upon the supposed decree of a free substance in contingent matters, a decree, however, which is never entirely arbitrary and free from foundation, but for which some reason can always be given. This reason, however, merely inclines and does not truly necessitate.[219] Such truth could itself be deduced from the analysis of concepts, if this were always within human power, and will certainly not escape the analysis of an omniscient substance who sees everything a priori from ideas themselves and from his decrees. It is certain, therefore, that all truths, even highly contingent ones, have a proof a priori, or some reason why they are rather than are not. And this is what is commonly asserted: that nothing happens without a cause, or there is nothing without a reason. Yet however strong this reason may be—though whatever kind it is, it is enough to effect a greater inclination in one direction or the other—even if it establishes certainty in a predicting being, it does not place necessity in the thing itself, because its contrary would still remain possible per se and implies no contradiction. Otherwise what we call contingent would rather be necessary, or of eternal truth.[220]

This axiom, however, that there is nothing without a reason, must be considered one of the greatest and most fruitful of all human knowledge, for upon it is built a great part of metaphysics, physics, and moral science; without it, indeed, the existence of God cannot be proved from his creatures, nor can an argument be carried from causes to effects or from effects to causes, nor any conclusions be drawn in civil matters. So true is this that whatever is not of mathematical necessity, as, for instance, are logical forms and numerical truths, must be sought here entirely. For example, Archimedes, or whoever is the author of the book on equilibrium, assumes that two equal weights placed in a balance in the same relation to its center or axis will be in equilibrium. This is merely a corollary of our axiom, for, since everything is assumed to be related in the same way on each side, there is no reason why the balance should tip to one side rather than the other.[221] But with this assumption Archimedes in turn proves other mathematical matters by necessity.

25

ON UNIVERSAL SYNTHESIS AND ANALYSIS, OR THE ART OF DISCOVERY AND JUDGMENT

1679(?)

Couturat has established the probability that this important paper on method, whose date is uncertain, belongs to the logical writings of 1679 or the years following and is "the sketch of a chapter of the Plus ultra."[222]

* * *

[G., VII, 292-98]

As a boy I learned logic, and, having already developed the habit of digging more deeply into the reasons for what I was taught, I raised the following question with my teachers. Seeing that there are categories for the simple terms by which concepts are ordered, why should there not also be categories for complex terms, by which truths may be ordered? I was then unaware that geometricians do this very thing when they demonstrate and order propositions according to their dependence upon each other. It seemed to me, however, that this could be achieved universally if we first had the true categories for simple terms, and if, to obtain these, we set up something new in the nature of an alphabet of thoughts, or a catalogue of the highest genera, or of those we assume to be highest, such as a, b, c, d, e, f, out of whose combination inferior concepts may be formed. For we must note that genera may serve as differentiae to each other, so that every difference can be conceived of as a genus, and every genus as a difference. It is as right to say "rational animal" as "animal rational being," if such a concept can be formed.[223] But, since our common genera do not reveal the species in their combination, I concluded that they were not correctly formed and that the genera next below the highest should be binions, such as *ab*, *ac*, *bd*, *cf*; the genera on the third level would be ternions, such as *abc*, *bdf*, and so on. But if the highest genera, or those assumed to be highest, should happen to be infinite, as is the case with numbers, we should only have to establish the order of these highest genera, and some order would then become apparent in the lower genera. For, in the case of numbers, the prime numbers can be taken as the highest genera, since all even numbers can be called binaries, all divisible by three, ternaries, and so forth. Then every derivative number can be expressed through prime ones as genera. Thus every multiple of six [senary] is a binary ternary. So, if some particular species is proposed, the propositions which are demonstrable about it could be enumerated in order, or all its predicates could be listed, whether broader than it or convertible with it, and the more meaningful could then be selected from these. Thus assume that there is a species *y*, whose concept is *abcd*; and for *ab* substitute *l*; for *ac*, *m*; for *ad*, *n*; for *bc*, *p*; for *bd*, *q*; for *cd*, *r*, which are binions. Then come ternions; for *abc* substitute *s*; for *abd*, *v*; for *acd*, *w*; for *bcd*, *x*. These would all be predicates of *y*, but only the following would be convertible with *y*: *ax*, *bw*, *cv*, *ds*; *lr*, *mq*, *np*. I have said more about this in my little treatise on the *Art of Combinations*, which I brought out soon after my adolescence, before the long-promised work of the same title by Kircher had appeared. I hoped to find similar matters discussed in it, but when it did appear, later, I found that it had merely revived the Lullian art or something similar to it but that the author had not even dreamed of the true analysis of human thoughts any more than had the others who have tried to reform philosophy.[224]

The primary concepts from whose combination the rest are made are either distinct or confused. Those are distinct which are understood through themselves, such as "being." Those are confused, though clear, which are perceived through themselves, such as color, because we can only explain them to someone else by showing them to him. For though the nature of color is analyzable, since it has a cause, we cannot sufficiently describe or recognize it by any concepts that are separately explained; it is known only confusedly and hence cannot be given a nominal definition. A nominal definition consists in the enumeration of signs or elements sufficient to distinguish the thing defined from everything else. If we proceed to seek the elements of the elements, we shall come at last to primitive concepts which have no elements at all, or none which we can explain to a sufficient degree. This is the art of dealing with distinct concepts. The art of dealing with confused concepts, however, must discover the distinct concepts which accompany the confused ones, whether these distinct concepts can be understood through themselves or can at least be resolved into such as are understood, for with their help we can sometimes arrive at some cause or resolution of the confused notion.

All derivative concepts, moreover, arise from a combination of primitive ones, and the more composite concepts from the combination of less composite ones. But one must take care that the combinations do not become useless through the joining-together of incompatible concepts. This can be avoided only by experience or by resolving them into distinct single concepts. One must be especially careful, in setting up real definitions, to establish their possibility, that is, to show that the concepts from which they are formed are compatible with each other. So while every reciprocal property of a thing can serve as its nominal definition, since all the other attributes of the thing can always be demonstrated from it, not every such property suffices for a real definition. For, as I have pointed out, there are certain properties which I call paradoxical, whose possibility can be doubted. For example, it can be doubted whether there is a curve for which it is true that, given any segment and any point on the curve, the lines connecting this point with the ends of the segment will always form the same angle. For, assuming that we have so adjusted the points of the curve to one segment, we still cannot foresee that what may seem to have succeeded by chance in one case will succeed in others, namely, that the same points on the curve will satisfy this condition with respect to another segment as well, since all of the points are now determined and no further ones can be assumed. Yet we know that this is the nature of a circle.[225] So, although someone might give a name to the curve having this property, it would not yet be certain that such a curve is possible, and hence that its definition is real. But the concept of the circle set up by Euclid, that of a figure described by the motion of a straight line in a plane about a fixed end, affords a real definition, for such a figure is evidently possible. Hence it is useful to have definitions involving the generation of a thing, or, if this is impossible, at least its constitution, that is, a method by which the thing appears to be producible or at least possible. I have already used this observation in the past to examine the imperfect demonstration which Descartes proposed of the existence of God, about which I have often argued in writing with the most learned Cartesians. Descartes argues as follows. Whatever can be demonstrated from the definition of a thing can be predicated of that thing. Now from the definition of God—that he is the most perfect being, or, as certain Scholastics said, a being than whom no greater can be thought—there follows his existence, for existence is a perfection, and whatever possesses existence will therefore be greater or more perfect than it would be without it. Therefore existence can be predicated of God, or God exists. This argument, revived by Descartes, was defended by one of the old Scholastics in a special book called Contra insipientem.[226] But, following some others, Thomas replied to it that this presupposes that God is, or, as I interpret this, that he has an essence, at least in the sense that the rose has an essence in winter, or that such a concept is possible. This therefore is the privilege of the most perfect being, that, given its possibility, it at once exists or that its existence follows from its essence or its possible concept. But, to make this demonstration rigorous, the possibility must first be proved. Obviously we cannot build a secure demonstration on any concept unless we know that this concept is possible, for from impossibles or concepts involving contradictions contradictory propositions can be demonstrated. This is an a priori reason why possibility is a requisite in a real definition. A difficulty raised by Hobbes can also be answered on this basis. For Hobbes saw that all truths can be demonstrated from definitions but held that all definitions are arbitrary and nominal, since we impose arbitrary names upon things. He therefore concluded that truths also consist merely in names and are arbitrary.[227] But we must recognize that, if we are to have a real definition, we cannot combine notions arbitrarily, but the concept we form out of them must be possible. Hence every real definition must contain at least the affirmation of some possibility. Furthermore, although names are arbitrary, once they are adopted, their consequences are necessary, and certain truths arise which are real even though they depend on the characters which have been imposed. For example, the rule of nines depends on characters imposed by the decimal system, yet it contains real truth. Moreover, to set up a hypothesis or to explain the method of production is merely to demonstrate the possibility of a thing, and this is useful even though the thing in question often has not been generated in that way. Thus the same ellipse can be thought of either as described in a plane with the aid of two foci and the motion of a thread about them or as a conic or a cylindrical section. Once a hypothesis or a manner of generation is found, one has a real definition from which others can also be derived, and from them those can be selected which best satisfy the other conditions, when a method of actually producing the thing is sought. Those real definitions are most perfect, furthermore, which are common to all the hypotheses or methods of generation and which involve the proximate cause of a thing, and from which the possibility of the thing is immediately apparent without presupposing any experiment or the demonstration of anything else. In other words, those real definitions are most perfect which resolve the thing into simple primitive notions understood in themselves. Such knowledge I usually call adequate or intuitive, for, if there were any inconsistency, it would appear here at once, since no further resolution can take place.[228]

From such ideas or definitions, then, there can be demonstrated all truths with the exception of identical propositions, which by their very nature are evidently indemonstrable and can truly be called axioms. What are popularly called axioms, however, can be reduced to identities by analyzing either the subject or the predicate or both, and so demonstrated; for, by assuming the contrary, we can show that the same thing would at the same time be and not be. Hence it is evident that in the last analysis the direct and indirect methods of demonstration coincide and that the Scholastics were right in observing that every axiom, once its terms are understood, may be reduced to the principle of contradiction. Thus any truth whatever can be justified, for the connection of the predicate with the subject is either evident in itself, as in identities, or can be explained by an analysis of the terms. This is the only, and the highest, criterion of truth in abstract things, that is, things which do not depend on experience—that it must either be an identity or be reducible to identities.

From this can be derived the elements of eternal truth in all things insofar as we understand them, as well as a method for proceeding demonstratively, as in geometry. In this way God understands everything a priori and through eternal truth, since he does not need experience and knows all things adequately, whereas we know hardly anything adequately, few things a priori, and most things through experience. In this last case other principles and other criteria must be applied. In factual or contingent matters, therefore, which do not depend on reason but on observation and experiment, primary truths (for us) are those that are perceived immediately within us or those of which we are conscious within ourselves. For it is impossible to prove these to ourselves through other experiences nearer or more intrinsic to us. But within myself I perceive not only myself who thinks but also many differences in my thoughts, from which I conclude that there are other things outside of me and gradually gain faith in my senses in opposition to the skeptics. For, in matters which do not possess metaphysical necessity, we must regard the agreement of phenomena as truth, since such agreement does not occur by chance but has a cause.[229] Certainly it is only through this agreement among phenomena that we distinguish dreams from waking, and we predict that the sun will rise tomorrow only because it has fulfilled our faith so often. To this is added the great power of authority and of public testimony, since it is not likely that so many should conspire to deceive us. To these factors can be added what Saint Augustine has said on the utility of faith.[230] The authority of the senses and of other witnesses once established, we may prepare a record of phenomena from which a mixed knowledge can be formed by combining with them truths abstracted from experience. But we need a particular art for arranging as well as for ordering and combining our experiments, so that useful inductions can be made from them, causes discovered, and general truths and postulates [aphorismi et praenotiones] set up. The carelessness of men is amazing, wasting their time in trifles and neglecting the matters by which they could take care of health and well-being. For perhaps they would have within their power the remedies for a great part of their ills if only they would make right use of the great wealth of observations already available to our century and of the true analysis. Our human knowledge of nature seems to me at present like a shop well provided with all kinds of wares but without any order or inventory.

The distinction between synthesis and analysis also becomes apparent from these considerations. Synthesis is achieved when we begin from principles and run through truths in good order, thus discovering certain progressions and setting up tables, or sometimes general formulas, in which the answers to emerging questions can later be discovered. Analysis goes back to the principles in order to solve the given problems only, just as if neither we nor others had discovered anything before.[231] It is more important to establish syntheses, because this work is of permanent value, while we often do work that has already been done in beginning the analysis of a particular problem. But it is a lesser art to use syntheses already set up by others and theorems already discovered, than by carrying out analysis, to achieve everything through one's own work, especially since we do not always remember or have at hand the truths which we ourselves or others have already discovered. Analysis is of two kinds. The common type advances by leaps and is used in algebra. The other is special and far more elegant but less well known; I call it "reductive" analysis.[232] Analysis is more necessary in practice, in order to solve problems that are given to us. But whoever is capable of more theoretical pursuits will be content to practice analysis only far enough to master the art but will then prefer to synthesize and will willingly tackle only such questions to which he is led by the order of research itself. In this way he will always progress pleasantly and easily and will not feel any difficulties or be disappointed in the outcome, for in a short time he will achieve much more than he could ever have hoped at the start. But ordinarily people destroy the fruits of their thinking through undue haste and attack too difficult problems at a leap, thus achieving nothing despite great effort. It must be realized that our method of inquiry is at last perfected when we can foresee whether it will lead us to a solution. Those who think that the analytic presentation consists in revealing the origin of a discovery, the synthetic in keeping it concealed, are in error.[233] I have often observed that, of the great geniuses of discovery, some are more inclined to analysis, others to the art of combinations. Combination or synthesis is the better means for discovering the use or application of something, as, for example, given the magnetic needle, to think of its application in the compass. Analysis, on the contrary, is best suited for discovering the means when the thing to be discovered or the proposed end is given. Analysis is rarely pure, however, for usually, when we search for the means, we come upon contrivances which have already been discovered by others or by ourselves either accidentally or by reason, and which we find stored up as in a table or inventory, either in our own memory or in the accounts of others, and which we now apply for our purpose. But this is synthesis. For the rest, the art of combinations in particular, as I take it (it can also be called a general characteristic or algebra), is that science in which are treated the forms or formulas of things in general, that is, quality in general or similarity and dissimilarity; in the same way that ever new formulas arise from the elements a, b, c themselves, when combined with each other, whether these elements represent quantities or something else. This art is distinct from common algebra, which deals with formulas applied to quantity only or to equality and inequality. This algebra is thus subordinate to the art of combinations and constantly uses its rules. But these rules of combination are far more general and find application not only in algebra but in the art of deciphering, in various games, in geometry itself when it is treated linearly in the manner of the ancients,[234] and, finally, in all matters involving relations of similarity.

26

Two Studies in the Logical Calculus

1679

In 1679 Leibniz thought of the logical calculus as an application of the more general science of characters to the problems of formal logic. Such an application would, he was convinced, put logic on a more universal basis and serve to convince men of the value of applying symbols to material truth as well. Of the two studies given here, the first was written in April, and the second probably later in the same year. In the former, the Elements of Calculus, he attempted to use numerical symbols, as he had suggested in Nos. 24 and 25, and to restrict logical operations to multiplication and division. His analysis was extended, in other studies dated in April, to the proof of the rules of immediate inference and the syllogism. In the second paper he abandoned numerical symbols and used letters, addition, and the simple relation esse. This approach was carried further in the later studies of the 1690's (No. 40).[235] Significant in the second selection is the beginning of an attempt to interpret the predicables in terms of his calculus.

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I

ELEMENTS OF CALCULUS

[Cout. OF., pp. 49-57]

1. A term is the subject or predicate of a categorical proposition. Thus I include neither the sign[236] nor the copula among the terms. So when it is said, "The wise man believes," the term is not believes, but a believer, just as if I say, "The wise man is a believer."

2. In what follows, I understand propositions to be categorical when I do not specifically indicate otherwise. But the categorical proposition is the basis of the rest, and all modal, hypothetical, disjunctive, and other propositions presuppose the categorical. I call A is B categorical, or A is not B, or it is false that A is B. When a variation in sign is added, the proposition is either universal and understood to apply to all of the subject or particular, applying to some.

3. To every term whatever may be assigned its characteristic number, which we may use in calculating, as we use the term itself in reasoning. I choose numbers in writing; in time I shall adapt other signs both to numbers and to speech itself. For the present numbers are the most useful because of their accuracy and the ease with which they are handled and because it is thus clear to the eye that all of the relations of concepts are certain and determined after the likeness of numbers.

4. The rule for discovering fitting characteristic numbers is this one only: when the concept of a given term is composed directly [in casu recto][237] out of the concepts of two or more other terms, then the characteristic number of the given term is to be produced by multiplying the characteristic numbers of the terms composing it. For example, since man is a rational animal, if the number of animal is a, for instance, 2, and the number of rational is r, for instance, 3, the number of man, or h, will be 2 x 3 or 6.[238]

5. We shall introduce letters (such as a, r, and h here) when the numbers are not given or at least need not be considered specifically but are dealt with in general, as it is proper for us to do here in dealing with the elements. This is, like the practice in symbolic algebra or the arithmetic of figures, a way of avoiding the effort to try to do for each individual case what can be shown at one and the same time for an infinite number of instances. I shall explain the manner of using these letters below.

6. The rule given in Article 4 suffices to include everything in the whole world in our calculus, insofar as we have distinct no-

tions of it, that is, insofar as we know certain of its constituents and can distinguish them from all others after examining them by their parts; in other words, insofar as we can assign a definition to them. For these constituents are nothing but the terms whose concepts compose the concept which we have of the thing. Moreover, we can distinguish most things from others by their constituents, and, if it is hard to decide which constituents belong to which, we can assign them some prime number temporarily and use it to designate other things by means of them. In this way we could at least discover all propositions by a calculation and show which ones can at least be demonstrated analytically when taken as primary for the time being, without actually being so. Thus Euclid nowhere uses the definition of a straight line in his demonstrations but presents something taken as axiomatic in place of it.[239] But, when Archimedes tried to go further, he was compelled to analyze the straight line and to define it as the least distance between two points. In this way we may thus discover, not all truths, indeed, but at least innumerable truths, those which are already demonstrated by others as well as those which could be demonstrated by others through definitions, axioms, and observations that are already known. And this is the advantage of our method—we can judge at once, through numbers, whether proposed propositions are proved, and so we accomplish, solely with the guidance of characters and the use of a definite method which is truly analytic, what others have scarcely achieved with the greatest mental effort and by accident. And therefore we can succeed in presenting conclusions within our own century which would scarcely be provided for mortals in many thousands of years otherwise.

7. To make clear the use of characteristic numbers in propositions, the following must be kept in mind. Every true categorical proposition, affirmative and universal, signifies nothing but a certain connection between the predicate and the subject—in the direct case, that is, of which I am always speaking here. This connection is such that the predicate may be said to be in the subject, or to be

contained in it, and this either absolutely and viewed in itself, or in some particular case. Or, in the same way, the subject may be said to contain the predicate; that is, the concept of the subject, either in itself or with some addition, involves the concept of the predicate. And therefore the subject and predicate may be mutually related to each other either as whole and part, or as whole and coinciding whole, or as part to whole.[240] In the first two cases the proposition is universal affirmative. So when I say, "All gold is a metal," I mean by this only that the notion of metal is contained in the notion of gold, in a direct sense, for gold is the heaviest metal. And when I say, "All pious people are happy," I mean only that the connection between piety and happiness is such that whoever understands the nature of piety perfectly will see that the nature of happiness is involved in it in the direct sense. But in every case in which either the subject or the predicate is a part or a whole, there will always occur a particular affirmative proposition. For example, some metals are gold; even if metal per se did not include gold, yet some metal, with an added or special quality, such as greater ductility, or coming from Hungary, has a nature that involves gold. But a distinction between the subjects of a universal and a particular proposition is found in the manner of this inclusion. For the subject of a universal proposition, viewed in itself and taken absolutely, must contain the predicate; so that the concept of gold, viewed in itself and taken absolutely, involves the concept of metal, since the notion of gold is that of the heaviest metal.[241] But in an affirmative particular proposition it suffices that the inclusion is successful when something is added to the subject. The concept of metal, viewed absolutely and in itself, does not involve the concept of gold; something must be added to involve it, namely, the sign of particularity. For it is some certain metal which contains the concept of gold. In the future, however, when we say that a term is contained in another, or a concept in another concept, we understand this to mean simply and in itself.

8. Negative propositions, however, merely contradict affirma-

tive ones and assert that they are false. Thus a particular negative proposition does nothing but deny that there is an affirmative universal proposition. So when I say, "Some silver is not soluble in common aqua fortis [nitric acid]," I mean this one thing: the universal affirmative proposition that all silver is soluble in common aqua fortis is false. For if we may believe certain chemists, there is an instance to the contrary, namely, that which they call luna fixa. A universal negative proposition, moreover, merely contradicts a particular affirmative. For example, if I say, "No wicked people are happy," I mean that it is false that some wicked people are happy. Thus it is clear that negatives can be understood from affirmatives, and affirmatives from negatives.[242]

9. Further, every categorical proposition has two terms. Any two terms whatever may differ in the following ways, insofar as they are said to be in, or not to be in, or to be contained in, or not contained in. Either one is contained in the other, or neither. If one is contained in the other, it may either be equal to the other, or they may differ as whole and part. If neither is contained in the other, then either they contain something in common or they differ entirely in genus. But we will explain these cases individually.

10. Two terms containing each other and yet equal, I call coincidents. For example, the concept of a triangle coincides in fact with the concept of trilateral; that is, exactly what is contained in one is also contained in the other, even though it may not sometimes appear so at first glance. But, if both terms are analyzed, they will coincide. Thus heaviest of metals and most stable of metals coincide, even though, speaking absolutely, heaviest and most stable do not coincide. This is clear from the example of mercury, for between the two metals, copper and quicksilver, the former is obviously the most stable, the latter the heaviest. But this is merely in passing.

11. Two terms, one of which contains the other but which are not coincident, are commonly called genus and species. Considered as concepts or component terms, as I am here viewing them, these

differ as part and whole, so that the concept of genus is part, the concept of species the whole, for it consists of genus and differentia. For example, the concept of gold and the concept of metal differ as whole and part, for the concept of metal and something more is contained in the concept of gold; for example, the concept of the heaviest among metals. Thus the concept of gold is greater than the concept of metal.

12. The schools speak otherwise, because they are considering not concepts but instances subsumed under universal concepts. Thus they say that metal is wider than gold, since it contains more species than does gold. If we were to count the individuals made of gold, on the one hand, and those made of metal, on the other, there would certainly be more of the latter than of the former, and hence the former would be contained in the latter as part in a whole. In fact, by applying this observation and using fitting characters, we could demonstrate all the rules of logic by another kind of calculus than the one developed here, merely by an inversion of our own calculus. But I prefer to consider universal concepts or ideas and their composition, for these do not depend on the existence of individuals.[243] So I say that gold is greater than metal, because more constituents are required for the concept of gold than for that of metal, and more is needed to produce gold than to produce any kind of metal whatever. Thus our phrases here and the Scholastic phrases do not contradict each other but must nevertheless be carefully distinguished. It will be clear to the careful student that I make no innovations in my way of speaking which do not have a definite reason and application.

13. If neither term is contained in the other, they are called *disparate*. In that case, to repeat what I have already said, either they have something in common or they differ entirely in genus. Terms have something in common when they fall under the same genus. These can be called *conspecies*; thus man and beast have the common concept animal, gold and silver that of metal, gold and vitriol that of mineral. Hence two terms clearly have more or less

in common according as their genus is more or less remote. For, if the genus is very far removed, it will also be a very small part of what the species symbolize. And when the genus is most remote, as, for example, substance, we say that the things are heterogeneous, or differ entirely in genus, as body and mind, not because they have nothing in common, since both are substances, but because this common genus is so far removed. From this it follows that whether two terms are to be called "heterogeneous" or not is a comparative matter. It suffices for our calculus that two things have nothing in common within certain limiting notions which we shall designate, even though they may have others in common.

14. Everything that we have so far said about terms that contain or do not contain each other in various ways, we may now transfer to their characteristic numbers. This is easy because, as we said in Article 4, when a term helps to constitute another term, that is, when the concept of one term is contained in that of another, then the characteristic number of the one enters by multiplication into the characteristic number assumed for the term so constituted. Or, what amounts to the same thing, the characteristic number of the term to be constituted (or that which contains the other) is divisible by the characteristic number of the constituting term (or that which is in the other). For example, the concept of animal enters into the formation of the concept of man, and so the characteristic number of animal, a (for example, 2), combines with some other number r (such as 3), to produce the number ar or h by multiplication (2 x 3); that is, the characteristic number of man. Hence the number ar or h (or 6) must necessarily be divisible by a (or by 2).

15. When two terms are coincident, however, for example, man and rational animal, their numbers too (h and ar) are in fact coincident. But since each term still contains the other in this case, that is, reciprocally, for man contains rational animal (but nothing more) and rational animal contains man (and nothing more which is not already contained in man), h and ar must necessarily contain each other (6 and 2 x 3), and this is indeed true, since they are co-

incident, and the same number is contained in itself. Besides, one must necessarily be divisible by the other, and this is true also, for, when any number is divided by itself, the quotient is one. What we said in the preceding section is therefore true for coincident terms as well; whenever one term contains another, its characteristic number is divisible by the characteristic of the other.

16. Hence we can also determine through characteristic numbers which term does not contain another. One has merely to test whether the number of one term can be divided exactly by the number of the other. For example, if the characteristic number of man is found to be 6, and that of the ape is 10, it is obvious that the concept of ape does not include that of man, nor that of man the ape, since 10 cannot be divided evenly by 6, nor 6 by 10. So if you wish to know whether the concept of wisdom is contained in that of a just being, that is, whether nothing more is required for wisdom than what is already contained in justice, you need merely to examine whether the characteristic number of just can be divided exactly by the characteristic number of wise. If the division is impossible, it will be clear that something more is required for wisdom than what is in justice, namely, a knowledge of reasons. For one can be just by custom or habit, even though he cannot give a reason for what he does. I will show later how that minimum which is necessary or must be added for the purpose can be discovered by characteristic numbers.

17. So we can learn in this way whether any universal affirmative proposition is true. For in such a proposition the concept of the subject, taken absolutely and indefinitely, and in general viewed in itself, always contains the concept of the predicate. For example, all gold is a metal, that is, the concept of metal is contained in the concept of gold generally and viewed in itself, so that whatever is assumed to be gold is by this fact assumed to be metal, since all the constituents of metal, such as being homogeneous to sense, becoming a liquid when fire is applied in a certain degree, and then not wetting other things immersed in it, are contained in the essen-

tials of gold. (We have explained how in Article 7.) Thus if we wish to know whether all gold is a metal—for it can be doubted whether fulminating gold is a metal, since it is in the form of powder and explodes rather than congeals when fire is applied in a certain way—we merely see whether the definition of metal is contained in it; that is, by a very simple procedure when characteristic numbers are introduced, we see whether the characteristic number of gold can be divided by the characteristic number of metal.

18. But in the particular affirmative proposition it is not necessary for the predicate to be contained in the subject per se and viewed absolutely, or for the concept of the subject per se to contain the concept of the predicate. It suffices that the predicate be contained in any species of the subject or that the concept of some instances or species of the subject contain the concept of the predicate; of what kind the species must be, the proposition need not express. Hence, if you say, "Some experts are prudent," this does not assert that the concept of prudence is contained in the concept of expert viewed in itself, though this is not denied, either. It suffices for our purpose that some species of expert has a concept which contains the notion of prudence, even though it is not made explicit what sort of species this may be, for instance, even if the proposition does not express that the expert who also possesses natural judgment is prudent. It is enough to understand that some species of expert involves prudence.

19. If the concept of the subject, viewed in itself, contains the concept of the predicate, then certainly the concept of the subject with additions, or the concept of a species of the subject, will contain the concept of the predicate. This is enough for us, for we do not deny that the predicate is in the subject itself when we say it is in a species of it. So we can say, "Some metal in fire (rightly applied) is a liquid," although we could express this more generally and usefully thus: "All metal in fire is a liquid." But a particular assertion has its uses, as when it is more easily demonstrated than a general one, or when the hearer may accept it more read-

ily than the universal, and the particular serves our purpose.

20. Since nothing more is required in a particular affirmative proposition than that a species of the subject contains the predicate, the subject will itself be related to the predicate either as species to genus, or as species to something coinciding with it or a reciprocal attribute, or as a genus to a species. That is, the concept of the subject will be related to that of the predicate, either as whole to part, or as whole to a coinciding whole, or as part to whole. (See above, Arts. 7 and 11.)

It will be related as whole to part when the concept of the predicate, as a genus, is in the concept of the subject as a species (for example, if "bernicle" is the subject and "bird" the predicate). It will be related as whole to coinciding whole when two equivalents are asserted of each other mutually, as is the case when "triangle" is the subject and "trilateral" the predicate. And, finally, it will be related as part to whole, as when "metal" is the subject and "gold" the predicate. Thus we can say, "Some bernicles are birds," "Some triangles are trilaterals" (though we might have affirmed these two propositions as universals as well), and, finally, "Some metal is gold." No particular affirmative proposition is possible in any other cases. I prove this as follows. If the species of the subject contains the predicate, it will certainly contain it in such a way that it coincides with it, or as a part. If equal or coincident with it, the predicate is certainly a species of the subject. If however the species of the subject contains the predicate as a part, the predicate will be a genus of the species of the subject, by Article 11. Thus the predicate and the subject will be two genera of the same species. Now two genera of the same species either coincide or, if they do not coincide, are necessarily related as genus and species. It is easy to show this, for the concept of a genus is formed from that of a species merely by casting off; therefore, if both genera are produced from the common species of two genera by a process of continued casting off, i.e., if both genera remain after the superfluous has been rejected, one will be produced before the other, and so one will be a whole, the other a part.

But this is a fallacy, and at once many things fail which we have said so far. For I now see that there are particular affirmative propositions also when neither term is genus or species, or when the terms are compatible, as some animals are rational. Hence it appears that the subject need not be divisible by the predicate or the predicate by the subject. We have obscured many things by the discussion so far, though we have been right about special cases; so we may now begin with the whole.[244]

II

SPECIMEN OF UNIVERSAL CALCULUS

[G., VII, 218-27]

1. A universal affirmative proposition is here expressed in this way: a is b, or (all) man is animal.[245] So we always understand the universal sign to be prefixed. We are not now discussing negative propositions or particular and hypothetical propositions.

2. A proposition true in itself:

ab is a, or (all) rational animal is animal.
ab is b, or (all) rational animal is rational.

Or, omitting b, a is a, or (all) animal is animal.

3. Conclusion true in itself:

If a is b, and b is c, then a is c. If (all) man is animal, and (all) animal is substance, then all man is substance.

4. From this follows:

If a is bd and b is c, then a is c. (All) man is rational animal; (all) animal is substance; hence (all) man is substance.

This may be demonstrated as follows. If a is bd, by hypothesis, and bd is b, by No. 2, then a is b, by No. 3. Further, if a is b (as we have proved), and bc is c, by hypothesis, then a is c, by No. 3.

5. A proposition is true which arises through logical conclusions from given propositions which are true in themselves.

Note. Although some propositions are to be assumed arbitrarily, such as definitions of terms, truths follow from them which are not arbitrary; for at least it is absolutely true that conclusions arise from such assumed definitions or, what amounts to the same thing, that the connection between conclusions, whether theorems and definitions or arbitrary hypotheses, is absolutely true. This is apparent in numbers, for instance, whose signs and decimal order are established by the will of man. Yet the calculations based on them signify absolute truths; that is, the connection between the assumed characters and the formulas deduced from them signify also the connections between things, which remain the same regardless of what characters are assumed. Moreover, it is useful to science to assume characters in this way, so that many conclusions may be drawn from few assumptions, which is the case when characters are assigned to the simplest elements of thought.

6. If one thing can be substituted anywhere in place of another without destroying truth, the other thing can be substituted conversely in place of the first. For example, since trilateral can be substituted in place of a plane triangular figure, a triangle can be substituted in place of a trilateral. For assuming two terms *a* and *b*, such that *b* can be substituted anywhere for *a*, then I say, *a* can be substituted anywhere in place of *b*. This I prove as follows. Assume the proposition *b* is *c*, or *d* is *b*; I say *a* can be substituted for *b* in these. For let us assume that it cannot be substituted, or that one cannot say that *a* is *c* and *d* is *a*; then these propositions are false. Then at least these two propositions are true: it is false that *a* is *c* and it is false that *d* is *a*. But, by hypothesis, *b* can be substituted for *a*; therefore these two propositions would also be true: it is false that *b* is *c*, and it is false that *d* is *b*. But this contradicts the hypothesis by which these are assumed to be true. So the proposition is proved. It can also be proved in other ways.

7. Terms are the *same* [*eadem*] if one can be substituted in place of the other without destroying truth, as triangle and trilat-

eral, quadrangle and quadrilateral.

8. All propositions (i.e., universal affirmative propositions; we are here dealing only with them) of which a given letter *a* is a part can be reduced to the following forms, however many others may seem enumerable.

a is *d*
ab is *e*
c is *a*

a is *fg* is reducible to *a* is *d*, assuming *fg* to be *d*.
a is *fhβ* is reducible to *a* is *d*, assuming *fhβ* to be *d*, or *hβ* to be *g*, and *fg* to be *d*, etc.
ab is *ik* is reducible to *ab* is *e*, assuming *ik* to be *e*, etc.
alm is *e* is reducible to *ab* is *e*, assuming *b* to be *lm*. *b* is *lm*, hence *ab* is *alm*.
alm is *ik* is reducible to *ab* is *e*, for *ik* is *e*, and *ab* is *alm*, etc.
np is *a* is reducible to *c* is *a*, assuming *c* to be *np*, etc.
q is *ab* (*abc*, etc.) is reducible to *q* is *a*, because *ab* is *a*.
rs is *ab* (*abc*, etc.) is reducible to *q* is *a*, assuming *rs* to be *q*, etc.
a is *a* is reducible to *d* is *a*, assuming *d* to be *a*, or to *a* is *c*, assuming *a* to be *c*.
a is *at* (*aθλ*, etc.) is reducible to *a* is *d*, assuming *at* to be *d*, or to *a* is *a*, because *at* is *a*.

$$\left.\begin{array}{l} \underline{ab}\text{ is }\begin{cases} \underline{a} \\ \underline{av} \\ \underline{awx}\ \text{(etc.)} \end{cases} \\ \underline{abc}\text{ is }\begin{cases} \underline{a} \\ \underline{az} \\ \underline{a\mu w}\ \text{(etc.)} \end{cases} \end{array}\right\}$$

All these can be analyzed in two ways from the foregoing ones, retaining *a* either in the subject or in the predicate.

All forms are reducible to the three given above, however, provided that we observe that for *df* or *dfg* or *bc* or *cn*, *ab*, *abc*, etc., can be placed one letter equal to this combination of more than one. So for the term "rational animal," for the sake of compactness, we place one term "man," and for the composite *ab* or *abc* in the given predicate we can substitute the simple term *a*. For if you say *c* is *ab*, or "Man is a rational animal," you can certainly say that *c* is *a*, or "Man is an animal." But it is otherwise in the subject, for, although I may say that all rational animals are man, I cannot say that all animals are men. Thus I cannot reduce the proposition *ab* is *c* to a more simple one, in which *a* remains an ingredient. The others I can, as appears from what has been said.

9. If *a* is *f* and *f* is *a*, *a* and *f* are the same, or one can be substituted in place of the other. I prove this as follows. I will show first that *f* can always be substituted in place of *a* itself. By the preceding section, namely, all propositions which contain *a* can be reduced to three forms: *a* is *d*, *ab* is *e*, and *c* is *a*. From this I show that the following three can be substituted: *f* is *d*, *fb* is *e*, and *c* is *f*. For since *f* is *a* and *a* is *d*, *f* will also be *d*. Likewise, since *f* is *a*, *fb* will be *ab* (by demonstration through addition), and, since *ab* is *e*, *fb* will be *e*. Finally, since *c* is *a*, and *a* is *f*, *c* will be *f*. In the same manner, moreover, in which I show that *f* can be substituted in place of *a*, it can also be shown that *a* can be substituted for *f*, since *a* and *f* are chosen arbitrarily, and also, since we showed substitution to be reciprocal, in Section 6, above.

A *being* is what is signified by any term such as *a* or *b* or *ab*.

Additions to the Specimen of Universal Calculus

To understand the nature of this calculus, we must note that whatever we express by certain letters which are assumed arbitrarily must be understood to be expressible in the same way by any others which we may assume. So when I say that this proposition, *ab* is *a*, is always true, I mean not merely that the example, "A rational animal is an animal," is true, assuming "animal" to be signified by *a* and "rational" by *b*, but I mean also that the example, "A rational animal is rational," is true, assuming "rational" to be signified by *a* and "animal" by *b*. And so we may proceed to any other example, such as an organic body is organic. And, therefore, we may also say *bd* is *b* instead of *ab* is *a*.

It is to be noted also that it makes no difference whether you say *ab* or *ba*, for it makes no difference whether you say "rational animal" or "animal rational being."

The repetition of any letter in the same term is useless, and it is adequate to retain it only once; for example, *aa* or man man.

Hence if *a* is *bc*, and *b* is *d*, and *c* is also *d*, it is useless to say that *a* is *dd*; it suffices that *a* is *d*. For example, man is a rational animal; all animals are sentient, and all reasoning beings are sentient; but it is useless to say that therefore man is a sentient sentient, for this is saying no more than that man is sentient. However, if one wishes to say that man is sentient in a double sense, this can itself be expressed in another way, following the rules of our characteristic.

Different predicates can be combined into one; if it is established that *a* is *b*, and also that *a* is *c*, it can be said that *a* is *bc*. So if man is an animal, and man is rational, man is a rational animal.

Conversely, one composite predicate can be divided into many. Thus *a* is *bd*; therefore *a* is *b* and *a* is *c*. For example, man is a rational animal; therefore man is animal and man is rational.

When this division is noted in itself, the composition can be demonstrated from it. For let us assume that man is an animal, and men are rational, but that man is nevertheless not a rational animal. Then the proposition would be false that man is a rational animal. This falsity can be proved only in three ways: one by showing that man is not an animal, which is contrary to hypothesis; another by showing that he is not rational, which is also contrary to hypothesis; the third that he cannot be both together or that the two are incompatible, which is also contrary to hypothesis, since we assumed that he is at once animal and rational.

Composition is possible in the subject, but not division. For if *b* is *a*, and *c* is *a*, *bc* is also *a*. If all animals live, and all reasoning beings live, surely all rational animals live. This is proved as follows.

bc is *b*, *b* is *a*, therefore *bc* is *a*.
bc is *c*, *c* is *a*, therefore *bc* is *a*.

Also, if we mix the composition and division of terms in various ways, there arise many results until now untouched by logicians, especially if we add negative and particular propositions besides.

If b is c, then ab is ac, or, if man is an animal, it follows that a wise man is a wise animal. This is proved as follows.

ab is b, b is c; therefore ab is c, by the first fule of conclusions.

ab is c, ab is a; therefore ab is ac, through the above demonstration.

But one cannot reason backward, that ab is ac, therefore b is c. For it may happen that a is ad, and bd is a. Yet if a and c have nothing in common, the conclusion would be valid that ab is ac. We propose here, however, to pursue only general consequences. Afterwards we will proceed to the more special ones, which are of greater importance than the general ones, and have not been treated heretofore according to their importance. For the whole analysis rests upon certain conclusions which seem to violate form but do not in fact violate the general conditions always observed in terms.

If a is b, and a is d, and d is b, ad is bd. This is demonstrable from the preceding. a is b, a is c, d is b, d is c, therefore ad is bc, assuming that c is d. It seems true from the preceding that so many assumptions are unnecessary, and that it suffices that a is b; hence ad is bd.

If a is b, and d is c, then ad is bc. This is an admirable theorem, which can be demonstrated in this way.

a is b, therefore ad is bd, by the above.

d is c, therefore bd is bc, also by the above.

ad is bd, and bd is bc, therefore ad is bc, which was to be demonstrated.

In general, if there is any number of propositions whatever: a is b, c is d, e is f, then one can be made from them: ace is bdf, by addition of the subjects on one side and the predicates on the other.[246]

In general, if there is a proposition m is bdf, three can be made from it, m is b, m is d, m is f.

All these things are easily proved if only this one thing be assumed—that the subject be the container, and the predicate at the same time be the contained or joined to the subject; or, on the contrary, that the subject be the contained and the predicate the alternative or conjunctive container.[247]

A *term* is *a*, *b*, *ab*, *bcd*; such as man, animal, rational animal, rational visible mortal.

I designate a *universal affirmative proposition* thus: *a* is *b*, or (all) man is animal. I wish this always to be the sign of universality, where *a* is the *subject*, *b* the *predicate*, and is the *copula*.

Postulate. It is permissible to assume a letter to be equivalent to one or more letters at once (so *d* is equal to *a*) and that it can be substituted in place of the other. *c* is equivalent to the term *ab*, or, for example, man is the same as rational animal. I mean this to hold, if nothing contrary to these assumptions has already been assumed.

Propositions true in themselves:

(1) *a* is *a*. Animal is animal.
(2) *ab* is *a*. Rational animal is animal.
(3) *a* is not non-*a*. Animal is not nonanimal.
(4) Non-*a* is not *a*. Nonanimal is not animal.
(5) What is not *a* is non-*a*. What is not an animal is nonanimal.
(6) What is not non-*a* is *a*. What is not a nonanimal is an animal.

From these many others can be derived.

Consequences true in themselves: *a* is *b*, and *b* is *c*, therefore *a* is *c*. God is wise, wise is just; therefore, God is just. This chain can be continued further. For example, God is wise, wise is just, just is austere; therefore God is austere.

Principles of the calculus. (1) *Whatever is concluded in certain indefinite letters must be understood to be concluded in whatever other letters have the same relation*. Thus, since it is true that *ab* is *a*, it is also true that *bc* is *b* and that *bcd* is *bc*. For substituting *e* for *bc* (by the postulate), it is the same as if we said, *ed* is *e*.

(2) The *transposition of letters* in the same term changes nothing; thus ab coincides with ba, or rational animal with animal reasoner.

(3) The repetition of the same letter in the same term is useless; thus b is aa, or bb is a; man is an animal animal, or man man is an animal. It suffices to say that a is b, or man is an animal.

(4) *From any number of propositions whatever one can be made by adding all the subjects into one subject, and all the predicates into one predicate.* a is b, and c is d, and e is f; hence ace is bdf. Thus God is omnipotent, man is endowed with a body. To be crucified is to suffer. Therefore a God-man crucified is an omnipotent being endowed with a body and suffering. It makes no difference if the terms sometimes combined in this way are inconsistent. Thus a circle is a null-angle. A square is a quadrangle. Therefore a square circle is a null-angled quadrangle. For the proposition is valid, though from an impossible hypothesis. This observation is especially useful in chains extended to more length, for example, in this way: God is wise, God is omnipotent, a just omnipotent being punishes the wicked. God does not punish some wicked people in this life. He who punishes, but does not punish in this life, punishes in another life. Therefore God punishes in another life.

(5) From any proposition whose predicate is composed of many terms, many propositions can be made of which each will have the same subject as the original but will have some part of the original predicate in place of the predicate. a is bcd; therefore, a is b, and a is c, and a is d. Or man is a rational, mortal, visible being. Therefore man is rational, man is mortal, and man is visible.

If a is b and b is a, then a and b are said to be the *same*. Thus every pious man is happy, and every happy man is pious. Therefore pious and happy are the same.

Hence it can easily be proved that one can be substituted anywhere in the place of the other, without destroying truth. Thus if a is b and b is a; and b is c, or d is a, then a is also c, and d is b. Thus all pious are happy, and all happy are pious, and all the happy are elect, and all martyrs are pious. Therefore all the pious are elect, and all martyrs are happy. (Note. By the pious I mean those persevering or dying in grace.)

Terms are *diverse* which are not the same, as man and animal, for even though all men are animals, not all animals are men.

a and *b* are *disparate*, if *a* is not *b*, and *b* is not *a*; as man and stone. For man is not a stone, and a stone is not a man. Thus all disparates are diverse, but not the converse.

If *a* is *m* and *b* is *m* and *a* and *b* are the same, then *m* is said to be *one*. Thus Octavianus is Caesar and Augustus is Caesar. But since Octavianus and Augustus are the same, only *one* Caesar will be counted. . . .

. . . If we assume any simple term whatever equivalent to any composite one, or expressing the same thing, the simple term will be *defined*, the composite term will be the *definition*. This defined term expressed by a character we will henceforth call the *name* of a thing. Thus if for *ab* we should say a rational animal, and for the sake of brevity, say *c* for man, then *c*, or the word "man," would be the name of the thing whose definition is rational animal, or the word "man" would be the name of men.

If in a universal affirmative proposition, the subject is a thing, but the predicate is neither a thing nor a definition but some other term, then this term is said to be an *attribute*. Thus the definition of God, whose name is God, is a most perfect being. His attributes are pity, omnipotence, creativity, being, being by itself. Thus if *c* is a thing and *ab* is its definition, and *c* is *d* (where *d* is not the term *ab*), then *d* is called the attribute of *c*.

If in a universal affirmative proposition the predicate is a thing, but the subject is not a thing or the definition of a thing but some other term, this term is called a *property* [*proprium*]. For example, all man is animal; thus man is "proper to" animal. For only an animal can be a man, even though all animal may not be man. We are not defining property here in the fourth mode, but in general, in the sense of what belongs to something alone. So if *c* is a thing and *ab* the definition of a thing, and the universal affirmative proposition *d* is *c* is given, *d* will be the property of, or proper to, *c*, though neither *c* nor *ab* is to be understood by the term *d*.

A *genus* is a common attribute. Thus the genus of the terms *d* and *e* is *a*, if *d* is *ab* and *e* is *ac*, or if *d* is *a* but *a* is not *d*.

The *proprium genus* is the attribute common to many, but of them alone. Thus animal is the proprium genus of men and beasts, or, if *d* is *a* and *e* is *a*, and if what is non-*d* and non-*e* is non-*a*, *a* will be the proprium genus of the species *d* and *e*.

An *accident* is a subject both in a particular affirmative proposition and in the negative with the same subject. So some men are learned and some men are not learned, therefore learning is an accident of man. If some *a* is *b* and some *a* is non-*b*, *b* is an accident of *a*.

A *proprium attribute* is obviously what is at once an attribute and a property. Namely, if the definition of a thing *c* (like man) is *ab* (rational animal) and there are given two propositions: *c* is *d* ("Man is a rational mortal"), in which *d* is an attribute, and *d* is *c* ("A rational mortal is man"): in which *d* is a property, it is obvious that *d* is a *proprium attribute*. It is also obvious that a name, a definition, and a proprium attribute are equivalent terms, or terms expressing the same thing. This is what is commonly called the property in the fourth mode, or the reciprocal property.

A *substantive*[248] is that (name) which includes (the name of a) being or thing. An adjective is what does not include it. Thus animal is a substantive, or the same as an animal being. Rational is an adjective, but it can become a substantive if you combine it with being, and say a rational being or, briefly in a word (if a jest be permitted), a rational. Thus from the term "animal being," the term "animal."

A *genus* is a substantive which is an attribute common to many, which are called species.

Attribute	Every differentia can be specific with another genus.	A specific difference is an adjective which, with the genus, constitutes a term equivalent to a species (or better, the definition of a species?). A generic difference is that which is the specific difference of a genus.

A *definition* is a composite substantive term equivalent to a species.

A *property* is an adjective, the subject of a universal proposition whose predicate is a substantive.

An *accident* is an adjective, the predicate of a subject of a particular affirmative proposition only.

27

Studies in a Geometry of Situation with a Letter to Christian Huygens

1679

Leibniz's interest in the application of the general characteristic to geometry seems to have been stimulated by a rereading of the first book of Euclid's Elements early in 1679. (His notes are given in GM., V, 183-211.) He proposed the new, nonquantitative approach in a letter to Huygens, which is also interesting for its report on the properties of phosphorus, and sent with the letter (I) an essay in which he developed fundamental geometrical definitions and relations on the basis of the relationship of congruence and the operations involved in it (II).[249] In a later second paper he used the less determinate but more general relationship of similarity in his demonstrations (III). Both relations are particular derivatives of the logical principle of identity or equivalence.[250] Leibniz's efforts to found such a geometry met with no response until Riemann and Grassmann, in the nineteenth century, undertook related studies. He returned to it several times, however, particularly in 1698-99 and near the close of his life (No. 69).

* * *

I

[GM., II, 17-20]

September 8, 1679

One of my friends, Mr. Hansen, who has had the honor of speaking with you, assures me that you continue to have a good opinion of me, for which I am much indebted to you. And I want to use this opportunity to witness how much I honor your extraordinary worth, which everyone recognizes as I do, and which places you in the highest rank.

I have learned from Mr. Mariotte that you will soon give us the dioptrics which we have so long desired. I am very eager to see it some day, and I should like to know in advance if you are satisfied with the reasons for refraction which Descartes proposes. I must admit that I am not entirely, any more than with Mr. Fermat's explanation in the third volume of Descartes's letters.[251]

I have left my manuscript on arithmetical quadratures at Paris so that it may some day be printed there. But I have advanced far beyond studies of this kind and believe that we can get to the bottom of most problems which now seem to lie beyond our calculation; for example, quadratures, the inverse method of tangents, the irrational roots of equations, and the arithmetic of Diophantus. I have some general methods which solve most of these things in a way as determinate as that used in ordinary algebra to solve an equation. And I am not afraid to say that there is a way to advance algebra as far beyond what Vieta and Descartes have left us as Vieta and Descartes carried it beyond the ancients. . . .

. . . But, in spite of the progress which I have made in these matters,[252] I am still not satisfied with algebra, because it does not give the shortest methods or the most beautiful constructions in geometry. This is why I believe that, so far as geometry is concerned, we need still another analysis which is distinctly geometrical or linear and which will express situation [situs] directly as algebra expresses magnitude directly. And I believe that I have found the way and that we can represent figures and even machines and movements by characters, as algebra represents numbers or magnitudes. I am sending you an essay which seems to me to be important. There is no one who can judge it better than you, Sir, and I should take your opinion in preference to those of many other men.

I am also sending you a little of the corporeal fire, which can well be called a perpetual light, for, when properly protected, it lasts many years without being consumed. It is a small piece but beautiful, for similar pieces are not always produced; usually the matter comes in small grains. I have put it in a bladder, and this is sealed in wax so that nothing can escape, and the piece will not take fire by motion or friction, as easily happens. Such a piece will be enough for many experiments, for the smallest particle is capable of making things radiant, and, when one takes it into his hands, they remain luminous for some hours, yet there is nothing visible in daylight. One can write with it in luminous letters, and some hours later, when these seem dead, they become visible afresh if rubbed once more. I hold that there is a true fire inclosed with the matter, but not concentrated enough to make itself felt. When one blows against it, the light disappears but returns immediately afterward, which is a remarkable thing. However, I have seen its vapor alone light a piece of paper which I was using to wipe my fingers when I emptied the container after I had produced the fire. It is easy to ignite gunpowder, either by the sun or through friction, after a little of this phosphorus is mixed with it. It would be good to try it in a vacuum. For the rest, I refer you to the experiments which I have reported to the Duke of Chevreuse. In order better to preserve this piece, one must spill a little water on it and keep it in a small well-corked glass bottle; otherwise it will evaporate in the air. In the water it will emit light at intervals, particularly when it is moved or warmed a little by contact with the hand; but, when it is dry and exposed to the air, it shines continuously. You need not be sparing with it, for I can let you have more, since I can make it. I beg you, Sir, to show its effects to Mr. Colbert, the Duke of Chevreuse, and the Academy. If you find them agreeable, I am inclined to communicate its composition to the Academy, though this would be difficult for me.

I beg you, Sir, to tell me something about scientific happenings there. Mr. Brousseau, the resident of my prince, who lives in the Rue des Rosiers behind little S. Antoine, will send me your letter.

You have heard mention of the attempt of Mr. Becher,[253] in Holland, to extract gold from sand. There are persons here who think well of him. Mr. Hudde is, as you know, one of the commissioners. Mr. Becher says he is also dealing with the French. I should like to know if you have heard talk about it in Paris. As for me, I am skeptical of his success, for I believe I know a little about the nature of his experiment. He does find a vestige of gold, but I do not think he has gained any of it, for he claims that the proportion of gold is greater in large than in small amounts, which is paradoxical.

II

Supplement

[GM., II, 20-27]

I have discovered certain elements of a new characteristic which is entirely different from algebra and which will have great advantages in representing to the mind, exactly and in a way faithful to its nature, even without figures, everything which depends on sense perception. Algebra is the characteristic for undetermined numbers or magnitudes only, but it does not express situation, angles, and motion directly. Hence it is often difficult to analyze the properties of a figure by calculation, and still more difficult to find very convenient geometrical demonstrations and constructions, even when the algebraic calculation is completed. But this new characteristic, which follows the visual figures, cannot fail to give the solution, the construction, and the geometric demonstration all at the same time, and in a natural way and in one analysis, that is, through determined procedure. Algebra is compelled to presuppose the elements of geometry;[254] this characteristic, instead, carries the analysis through to its end. If it were completed in the way in which I think of it, one could carry out the description of a machine, no matter how complicated, in characters which would be merely the letters of the alphabet, and so provide the mind with a method of knowing the machine and all its parts, their motion and use, distinctly and easily without the use of any figures or models and without the need of imagination. Yet the figure would inevitably be present to the mind whenever one wishes to interpret the characters. One could also give exact descriptions of natural things by means of it, such, for example, as the structure of plants and animals. With its aid people who find it hard to draw figures could explain a matter perfectly, provided they have it present before them or in their mind, and could transmit their thoughts and experiences to posterity—a thing which cannot be done today because the words of our languages are not sufficiently fixed or well enough fitted for good explanations without figures.

This is the least useful aspect of this characteristic, however, for, if only description were involved, it would be better—assuming that we can and are willing to bear the expense—to have figures and even models or, better still, the original things themselves. But its chief value lies in the reasoning which can be done and the conclusions which can be drawn by operations with its characters, which could not be expressed in figures, and still less in models, without multiplying these too greatly or without confusing them with too many points and lines in the course of the many futile attempts one is forced to make. This method, by contrast, will guide us surely and without effort. I believe that by this method one could treat mechanics almost like geometry, and one could even test the qualities of materials, because this ordinarily depends on certain figures in their sensible parts. Finally, I have no hope that we can get very far in physics until we have found some such method of abridgment to lighten its burden of imagination. For example, we see what a series of geometrical reasoning is necessary merely to explain the rainbow, one of the simplest effects of nature; so we can infer what a chain of conclusions would be necessary to penetrate into the inner nature of complex effects whose structure is so subtle that the microscope, which can reveal more than the hundred-thousandth part, does not explain it enough to help us much. Yet there would be some hope of achieving this goal, at least in part, if this truly geometrical analysis were established.

But since I have found no one else who has ever come upon this thought, and am therefore apprehensive that it will be lost if I do not have the time to carry it out, I shall here add an essay which seems to me to be important and which will at least suffice to make my plan more plausible and easier to understand. If therefore some circumstance prevents its perfection at present, this essay will serve as a witness to posterity and give occasion for someone else to carry it through.

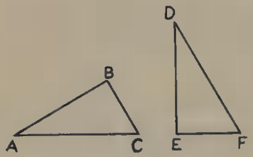

Fig. 1

It is well known that nothing is more important in geometry than the consideration of loci. I shall therefore express one of the simplest of these by characters of this kind. The letters of the alphabet will ordinarily signify the points of figures. Letters at the beginning, such as A and B, will express given points; letters at the end, such as X and Y, unknown points. Instead of using equalities or equations as in algebra, I shall here use relations of congruence, which I shall express by the character ♉. For example, in the first figure (Fig. 1), ABC ♉ DEF means that the triangles ABC and DEF are congruent with respect to the order of their points, that they can occupy exactly the same place, and that one can be applied or placed on the other without changing anything in the two figures except their place. So if one places D upon A, E upon B, and F upon C, the two triangles, which are assumed to be equal and similar, obviously coincide. But without speaking of triangles, one can, in a way, still say the same thing about points, or about ABC ♉ DEF in Figure 2; that is, one can at the same time place A upon D, B upon E, and C upon F without the situation of the three points ABC being changed in relation to each other or that of the three points DEF to each other, assuming in this that the first three points are connected by rigid lines (whether straight or curved does not matter) and the other three likewise. After this explanation of our characters, we develop the following loci.

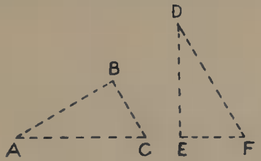

Fig. 2

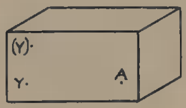

Fig. 3

Let A ♉ Y (Fig. 3); that is, given a point A, to find the locus of all points Y, or (Y),[255] which are congruent with A. I assert that the locus of all these Y's will be a space infinite in all directions. For all the points in the world are congruent to each other; that is, one can always be put in place of another. But all the points in the world are in the same space. This locus can also be expressed thus: Y ♉ (Y). This is all very obvious, but we must begin at the beginning.

Let AY ♉ A(Y) (Fig. 4). The locus of all Y's will be the surface of a sphere whose center is A and whose radius is AY, which is always the same in length or equal to a given segment AB or CB. For this reason we can express the same locus as AB ♉ AY, or CB ♉ AY.

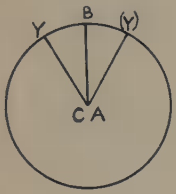

Fig. 4

Let AX ♉ BX (Fig. 5). The locus of all X's will be a plane. Two points, A and B, being given, to find a third, X, which has the same situation in relation to A as it has to B (that is, AX shall be equal or congruent to BX, since all equal straight lines are congruent, or point B can be placed on point A without changing the situation it had in relation to X). I assert that all points X, (X) of a single definite plane extending to infinity will satisfy this condition. For just as AX ♉ BX, so A (X) ♉ B(X). But there is no point outside the plane which will satisfy this condition. Therefore this infinitely extended plane will be the common locus of every point in the universe situated in relation to A as it is to B. (It follows that this plane will pass through the midpoint of the straight line AB, which is perpendicular to it.)[256]

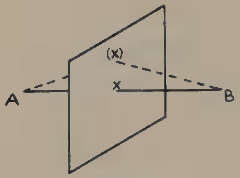

Fig. 5

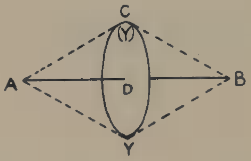

Fig. 6

Let ABC ♉ ABY (Fig. 6). The locus of all Y's will be circular. That is, given three points A, B, C; to find a fourth point Y which has the same situation as C in relation to AB. I assert that there is an infinity of points which satisfy this condition and that the locus of all these points is a circle. This description or definition of a circular line does not, as does Euclid's, presuppose a plane or even a straight line. Yet it is clear that the center of the circle is D, between A and B. This can also be said in this way: ABY ♉ AB(Y); then the locus would be a circle that is not given. A given point must therefore be added.[257] We can imagine that the two points A and B remain fixed and that point C, attached to them by certain rigid lines, straight or curved, and consequently preserving the same situation in relation to them, is turned around AC so as to describe the circle CY(Y). We can conclude from this that the situation of one point in relation to another can be thought of without expressing the straight line joining them, provided they are thought of as joined by some line, whatever it may be; and, if this line is assumed to be rigid, the situation of the two points in relation to each other will be immutable. Two points can be thought of as having the same situation in relation to each other as two other points have, if the one pair can be joined by a line which is congruent with the line joining the other pair. I say this so that it can be seen that nothing which I have said so far depends on the straight line, whose definition I am about to give, and that there is a difference between the points A and C, the situation of A and C in relation to each other, and the straight line AC.

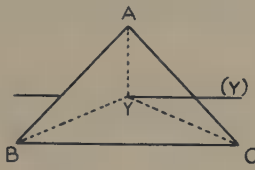

Fig. 7

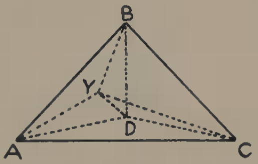

Fig. 8

Let AY ♉ BY ♉ CY (Fig. 7). Then the locus of all Y's will be a straight line. That is, given three points, to find a point Y which has the same situation in relation to A as it has to B and to C. I assert that all such points will fall on an infinite straight line Y(Y). If this were all limited to a plane, two given points would suffice to determine a straight line in this way.[258]

Finally, let AY ♉ BY ♉ CY ♉ DY (Fig. 8). The locus will be a single point, for we seek a point Y which has the same situation relative to each of the four given points A, B, C, and D. That is, the straight lines AY, BY, CY, and DY shall be equal to each other, and there is only one point which will satisfy this condition.

These same loci can be expressed in many other ways, but these are the simplest and most fruitful and can pass for definitions. To show that these expressions are useful in reasoning, I shall, before closing, demonstrate the nature of the intersections between these loci by means of their characters.

First, the intersection of two spherical surfaces is a circle.[259] The expression of a circle is ABC ♉ ABY; hence AC ♉ AY and BC ♉ BY. But the loci corresponding to these congruences are two spheres, one with center A and radius AC, the other with center B and radius BC.

The intersection of a plane and a sphere is likewise a circle. For the expression of a sphere is *AC* ♉ *AY*, and that of a plane is *AY* ♉ *BY*. Hence *AC* ♉ *BC*, since point *C* is one of the points *Y*. Now, since *BC* ♉ *AC*, and *AC* ♉ *AY*, it follows that *BC* ♉ *AY*; and, since *AY* ♉ *BY*, we have *BC* ♉ *BY*. Joining these congruences together, we have *ABC* ♉ *ABY* or *AB* ♉ *AB*, *BC* ♉ *BY*, and *AC* ♉ *AY*. But *ABC* ♉ *ABY* is the expression of a circle, which was here to be proved by this kind of calculus.

In the same way it is shown that *the intersection of two planes is a straight line*. For let there be two congruences: *AB* ♉ *BY* for one plane, and *AY* ♉ *CY* for another plane. Then we will have *AY* ♉ *BY* ♉ *CY*, whose locus is a straight line. Finally, *the intersection of two straight lines is a point*. For let *AY* ♉ *BY* ♉ *CY*, and *BY* ♉ *CY* ♉ *DY*; then we have *AY* ♉ *BY* ♉ *CY* ♉ *DY*.

I have only one comment to add; namely, that I see the possibility of extending the characteristic to things which are not subject to sensory imagination. But this is so important and has so many implications that I cannot explain it here in a few words.

III

ON ANALYSIS SITUS[260]

[G., V, 178-83]

What is commonly known as *mathematical analysis* is analysis of *magnitude*, not of *situation*, and as such it pertains directly and immediately to arithmetic but is applicable to geometry only in an indirect sense. The result is that many things easily become clear through a consideration of situation, which the algebraic calculus shows only with greater difficulty. To reduce geometric problems to algebra, i.e., to reduce problems determined by figures to equations, is often a rather prolonged affair, and further complications and difficulties are necessary to return from the equation to the construction, from algebra back to geometry. Often, too, the constructions produced in this way are not entirely appropriate, unless we are lucky enough to stumble upon unforeseen postulates and assumptions. This Descartes himself tacitly admitted in solving a certain problem of Pappus in Book III of his Geometry. In fact, algebra, whether using numbers or symbols, adds, subtracts, multiplies, divides, extracts roots, all of which are arithmetical. For logistics itself, or the science of magnitude and proportion in general, deals only with general or indeterminate number and with the species of operations performed on it, since magnitude is in fact measured by the number of determinate parts, yet this number may vary for the same fixed thing, depending upon which measure or unit is assumed. It is not surprising, therefore, that the science of magnitude in general is a kind of arithmetic, since it deals with indeterminate numbers.

The ancients had another kind of analysis, different from algebra, which was concerned rather with considering situation. It deals with data and with the positions of the unknown entities or their loci. This is the trend of Euclid's book De datis, on which there exists a commentary by Marinus.[261] Apollonius particularly, but others as well, dealt with plane, solid, and linear loci; more recent thinkers have reconstructed the doctrine of plane and solid loci from his propositions as preserved by Pappus, but in such a way as to show merely the truth rather than the source of the ancient doctrine. Yet this kind of analysis does not reduce the matter to a calculation, nor is it carried through to the first principles and elements of situation, as is necessary for a perfect analysis.

The true analysis of situation is therefore still to be supplied. This can be shown from the fact that all analysts, whether they use algebra in the new manner or deal with the given and the unknown after the ancient pattern, have to assume many things from elementary geometry which are not derived from the consideration of magnitude but from that of figure, and which have not yet been explained in any determinate way. Euclid himself was forced to assume certain rather obscure axioms, without proof, in order to proceed with the rest. And the demonstration of theorems and the solution of problems in his Elements sometimes seem to be achieved through hard labor rather than method and skill, even though he also seems sometimes to conceal the ingenuity of his method.

Besides quantity, figure in general includes also quality or form. And as those figures are equal whose magnitude is the same, so those are similar whose form is the same. The theory of similarities or of forms lies beyond mathematics and must be sought in metaphysics. Yet it has many uses in mathematics also, being of use even in the algebraic calculus itself. But similarity is seen best of all in the situations or figures of geometry. Thus a true geometric analysis ought not only consider equalities and proportions which are truly reducible to equalities but also similarities and, arising from the combination of equality and similarity, congruences.

The true reason why geometricians have not made enough use of a theory of similarity is, I think, this. They did not have any general concept of it which was sufficiently distinct or adapted to mathematical investigation; this is a fault of philosophers, who usually are content, especially in metaphysics, with vague definitions which are fully as obscure as the thing defined. Hence it need not surprise anyone that this doctrine is usually barren and verbose. Thus it is not enough to designate objects as similar whose form is the same, unless a general concept is further given of form. In undertaking an explanation of quality or form, I have learned that the matter reduces to this: things are similar which cannot be distinguished when observed in isolation from each other. Quantity can be grasped only when the things are actually present together or when some intervening thing can be applied to both. But quality presents something to the mind which can be known in a thing separately and can then be applied to the comparison of two things without actually bringing the two together either immediately or through the mediation of a third object as a measure. Let us imagine that two temples or buildings are constructed according to this law: that nothing can be found in one which you do not also find in the other. The material is everywhere the same, white Parian marble, if you like; the proportions of walls, columns, and all the rest are everywhere the same; the angles are everywhere equal or in the same ratio to a right angle. If anyone is led into these two temples blindfolded, and his eyes are uncovered after he has entered and he walks about, first in one and then in the other, he will receive no clue from them by which to distinguish one from the other. Yet they may actually differ in magnitude, and might be distinguished if viewed at the same time from the same place, or also (assuming that they are some distance apart) if some third object be carried from one to the other and compared with them—if, for instance, some measure such as a yard or a foot or any other appropriate unit, be applied first to one and then to the other. Only then will there be a ground for distinguishing them with regard to the discovered inequality. Similarly, if the body of the spectator himself, or one of its members, which of course moves from place to place with him and may serve as a measure, is compared with these temples, then too their magnitudes will appear different and thus give a basis for distinguishing them. But if you consider the spectator only as a seeing mind concentrated at a point as it were, without any magnitude about him, either really or in his imagination, and have regard only for those aspects of things which the intellect can follow, such as numbers, proportions, and angles, no distinction will appear. These temples are therefore called similar, because they can be distinguished only by being observed together, either directly with each other or with a third something, but it is impossible to distinguish them singly and when seen by themselves.[262]

This clear, practical, and universal description of similarity will be useful to us in geometrical demonstrations, as will appear directly. For we call two presented figures similar if nothing can be observed in one, viewed by itself, which cannot be equally observed in the other. Thus it follows that there should be the same ratio of proportion of parts in both cases; otherwise a distinction would appear even when each is viewed by itself, without any direct observation of both together. But, lacking a general concept of similarity, geometricians have defined figures as similar whose corresponding angles are equal. This is a special case which does not reveal the nature of similarity in general. As a result they had to proceed indirectly to prove propositions which follow at the first glance from our definition. But let us come to examples.

In the *Elements* it is shown that similar or equiangular triangles have proportional sides, and the converse. But Euclid uses many detours to achieve this demonstration, and then only in the fifth book, whereas he might have shown it in the first if he had used our concept. First we shall demonstrate that *equiangular triangles are similar*. Given two triangles *ABC* and *LMN* (Fig. 9), whose angles *A*, *B*, and *C* and *L*, *M*, and *N* are, respectively, equal. I say the triangles are similar. I use this *new axiom*: *things which cannot be distinguished through their determinants* (*or through data adequate to define them*) *cannot be distinguished at all*, since all other properties arise from these data.[263] Now given the base *BC* and the angles *B* and *C* (and hence also the angle *A*), the triangle *ABC* is given; likewise, given the base *MN* and the angles *M* and *N* (and hence also the angle *L*), the triangle *LMN* is given. But from these properties sufficient to determine the triangles, they cannot be distinguished if viewed singly. For in each triangle the base and two adjacent angles are given, but the base cannot be compared with the angles. Therefore there remains nothing which can be examined in either triangle viewed singly by its determinants, except the ratio of each given angle to a right angle or to two right angles, that is, the magnitude of the angle itself. And since these are found to be the same in both

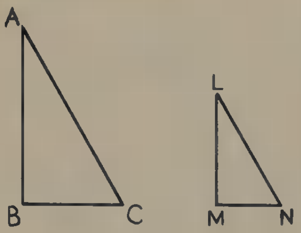

Fig. 9

triangles, it follows necessarily that the triangles singly cannot be distinguished and therefore are similar. For I may add as a scholium that, although the triangles can be distinguished by magnitude, magnitude can be known only by observing together either both triangles at the same time or each with some other unit of measure. But in this case they would not be merely viewed separately, as was postulated.

The converse is also clear, that *similar triangles are equiangular*. Otherwise, if there were some angle *A* in the triangle *ABC* to which no equal one is found in triangle *LMN*, there would be given an angle in *ABC* having a ratio to two right angles (or to the sum of the angles of the triangle) which no angle has in *LMN*, and this suffices to distinguish the triangle *ABC*, viewed separately, from triangle *LMN*. It is also shown that *similar triangles have proportional sides*. For if some two sides were given, such as *AB* and *BC* which have a ratio to each other which no two sides of *LMN* have, then one triangle could be distinguished from the other, even viewed singly. Finally, *if their sides are proportional, triangles are similar*, for if the sides are given, the triangles are given, and it suffices (according to our axiom) that no basis for distinguishing them can be found in the ratio of the sides, so that we may conclude that such a distinction can be found in no other circumstance in the triangles viewed singly. It is also clear from this that *equiangular triangles have proportional sides*, and the converse.

In the same way it is shown directly and at first glance from our concept of similarity that *circles are to each other as the squares of their diameters*, which Euclid shows only in his tenth book, and then by using inscribed and circumscribed figures and a *reductio ad absurdum*, whereas no such roundabout methods are necessary. Given a circle with a diameter *AB* (Fig. 10) and *CD*, the square on the diameter circum-

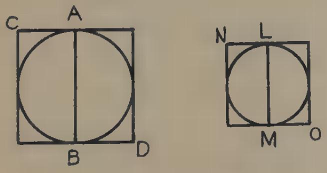

Fig. 10

scribed about it. In the same way let a circle be described with a diameter *LM*, and the square *NO*, or its diameter, circumscribed about it. The determinants are similar in both figures, circle to circle, square to square, and relation of circle to square; so by the above axiom, figures *ABCD* and *LMNO* are similar. Therefore, by definition of similarity, the circle *AB* is to the square *CD* as the circle *LM* is to the square *NO*, and hence the circle *AB* is to the circle *LM* as the square *CD* is to the square *NO*, which was to be proved. In the same way it is proved that *spheres are to each other as the cubes of their diameters* and, in general, that in similar figures lines, surfaces, and volumes are proportional, respectively, to lengths, squares, and cubes of corresponding sides. Until now this has been more generally assumed than proved.

Furthermore, this point of view, which offers such facility in demonstrating truths which have been proved only with difficulty by other methods, also opens a new type of calculus to us which is far different from the algebraic calculus and is new both in its symbols and in the application it makes of them or in its operations. I like to call it *Analysis Situs*, because it explains situation directly and immediately, so that, even if the figures are not drawn, they are portrayed to the mind through symbols; and, whatever the empirical imagination understands from the figures, this calculus derives by exact calculation from the symbols. All other matters which the power of imagination cannot penetrate will also follow from it. Therefore this calculus of situation which I propose will contain a supplement to sensory imagination and perfect it, as it were. It will have applications hitherto unknown not only in geometry but also in the invention of machines and in the descriptions of the mechanisms of nature.

28

Letter to John Frederick, Duke of Brunswick-Hanover

Fall, 1679

The Treaty of Nijmwegen, signed February 5, 1679, and the concern of the reigning pope, Innocent XI, for a moral deepening of the Church of Rome and a return of Protestants from their apostasy, increased the spirit of tolerance between Catholic and Protestant branches of Christendom. Leibniz believed the time ripe for a revival of his great apologetic project, the Catholic Demonstrations, and he turned to his patron as the Catholic prince whose support would make it the spearhead of an effort to bring about church unity. The papal legate Spinola had visited Hanover for the second time with a message from the pope, and Leibniz had begun his long correspondence on the terms of union with Bossuet, whose Exposition de la foi de l'église catholique had won papal approval. After John Frederick's death late in the same year, Leibniz shifted his efforts to win princely patronage to another Catholic, Ernest of Hesse-Rheinfels, who was close to the great thinker, Antoine Arnauld, whom Leibniz had first sought to interest in his proposal (No. 10).

* * *

[PA., II, i, 487-88]

The departure of your serene highness and the conjuncture of the times compel me to touch upon a matter which I have weighed carefully. But lost time and opportunity never return, as I have already experienced on another occasion, and motives of piety and the public good must take precedence over all other considerations.

Your serene highness should know, then, that I frequently examined the controversies of theology most thoroughly with the late Baron von Boineburg and that we concluded at last that the Council of Trent can without difficulty be approved in its entirety except for three or four passages. It seems to me that, in order to avoid opinions involving contradictions, we must give an interpretation to these which, I believe, is contrary neither to the words nor to the opinions of the Catholic church, though it is far removed from the common opinions of certain Scholastic theologians, especially from those of the monks. To speak candidly and without reservations: since these men have a great ascendancy over people's minds, as is testified by the trouble they gave Galileo, I told him frankly that I should have no difficulty in submitting and in making public avowal of this, if a declaration could be obtained from Rome assuring me that these interpretations, which seemed to me the true ones, are at least tolerable and contain nothing heretical or contrary to faith. Then, if this were done, I should set about arranging everything in so clear a light that my work could perhaps contribute something to reunion in its time.

The late Baron was enthusiastic about this proposal, and, when I made my journey to France, he gave me letters to Mr. Arnauld, for he believed that his opinions could carry great weight. But in order not to show myself ill-timed, I moved with all possible circumspection, and the death of the Baron came unexpectedly and removed my hope of succeeding along this path. So I did not explain my views to Mr. Arnauld but from that time on began to think of your serene highness, especially because I knew that the Baron von Boineburg had planned to speak to you, for still more particular reasons which I shall give in their place.

Now, assuming that these declarations were obtained from Rome, I had formed the plan of a work of first importance, which the Baron most heartily approved. Its title was Catholic Demonstrations. It was to contain three parts. The first was to deal with the demonstrations of the existence of God, of the immortality of the soul, and of all natural theology; for I did in fact have some surprising ones. The second part was to be about the Christian religion, or revealed theology, where I sought to demonstrate the possibility of our mysteries and to meet all the objections of those who claim to show the absurdity and the contradictions in the Trinity, the Incarnation, the Eucharist, and the resurrection of the body. For the proofs of the Christian religion are only moral, since it is impossible to give any other kind of proof in matters of fact. But every proof which carries only moral certainty can be destroyed by stronger contrary proofs; consequently, we must reply to objections in order to satisfy ourselves entirely, since a single impossibility proved of our mysteries would destroy the whole structure. The third part was to treat of the church; here I have convincing proofs that the church hierarchy is of divine right, and I distinguish the limits of secular and ecclesiastical power exactly. Churchmen themselves, namely, and all other men, owe an external obedience to sovereigns, but only usque ad aras,[264] and at least an unreserved suffrance to the rest. For example, the first Christians did not obey the most impious commandments of the pagan emperors, but they also did not oppose force to force. In exchange, all men, including sovereigns, owe an interior obedience to the church, that is, an unreserved deference in matters of faith, as far as this is possible for them. (This reservation is necessary, for if a man happens to believe that he sees a contradiction in what the church commands him to believe, it will be impossible for him to have faith in it, and he will be a heretic, though only materially. This alone will not prevent his being saved.) So we see that we owe a passive obedience, or nonresistance, to sovereigns, and an active obedience, so far as is in our power, to the church. In terms of these principles I give an easy and clear solution to the most disturbing questions.[265]

But, in order to lay the basis for these great demonstrations, I plan to preface them with the demonstrated elements of the true philosophy to help in understanding the main work. We need a new logic in order to know degrees of probability, since this is necessary in judging the proofs of matters of fact and of morals, where there are unually good reasons on both sides and we are concerned only to know on which side to tip the scales. But the art of weighing probabilities is not yet even partly explained, though it would be of great importance in legal matters and even in the management of business. We must also push metaphysics further than has been done so far, in order to have true notions of God and the soul, of person, substance, and accidents. And unless we have a profounder insight into physics, we cannot meet the objections raised against the history of creation, the deluge, and the resurrection of the body.[266] In short, the true morality must be demonstrated, in order to learn what is justice, justification, freedom, pleasure, happiness, and the beatific vision. And, to conclude, nothing conforms more truly with a true politics and the true happiness of mankind, even here below and in this life, than does my proposal about the inviolable and irresistible power of the sovereign over external goods and of the internal rule which God exercises over souls through the church. It seems to me that I have already said to your serene highness on other occasions that nothing is more useful for the general good than the authority of a universal church which forms a body of all Christians, united by bonds of charity, and which can hold in sacred respect the greatest powers on earth as long as they are still sensible to the reproaches of their consciences. Every man of good will [homme de bien] should therefore desire that the luster of the church may everywhere be restored and that the spiritual power of its true ministers over the faithful may be more fully recognized than is often done, even among those who would pass as the most Catholic.

But disputes are more customary than demonstrations in philosophy, morals, and theology, and most readers will have the prejudices about such a project that are usual about works dealing with these matters; for it will be thought that the author has merely transcribed and problematized and is probably a superficial mind little versed in the mathematical sciences and consequently hardly capable of true demonstration. In view of these considerations I have tried to disabuse everyone by pushing myself ahead a little further than is common in mathematics, where I believe I have made discoveries which have already received the general approval of the greatest men of the day and which will appear with brilliance whenever I choose. This was the true reason for my long stay in France—to perfect myself in this field and to establish my reputation, for when I went there I was not yet much of a geometrician, which I needed to be in order to set up my demonstrations in a rigorous way. So I want first to publish my discoveries in analysis, geometry, and mechanics, and I venture to say that these will not be inferior to those which Galileo and Descartes have given us. Men will be able to judge from them whether I know how to discover and to demonstrate. I did not study the mathematical sciences for themselves, therefore, but in order some day to use them in establishing my credit and furthering piety.

There is another important thing in my philosophy which will give it access to the Jesuits and other theologians. This is my restoration of substantial forms, which the atomists and Cartesians claim to have exterminated. It is certain that, without these forms and the distinction that exists between them and real accidents, it is impossible to explain our mysteries. For if the nature of body consists in extension, as Descartes claims, it involves a contradiction, beyond all doubt, to maintain that a body may exist in many places at once. But all that has been said about the essence of body until now is unintelligible, and it is not surprising that substantial forms have been taken for chimeras by the most able minds. What I shall say about them, among other things, will instead be as intelligible as anything that the Cartesians have ever proposed about other matters.

Finally, to render my demonstrations absolutely incontestable, and as certain as anything that can be proved by arithmetical calculation, I shall offer an essay on my new writing or characteristic, or, if you prefer, language. This is undoubtedly one of the greatest projects to which men have ever set themselves. It will be an instrument even more useful to the mind than telescopes and microscopes are to the eyes. Every line of this writing will be equivalent to a demonstration. The only fallacies will be easily detected errors in calculation. This will become the great method of discovering truths, establishing them, and teaching them irresistibly when they are established. Nothing could be proposed that would be more important for the Congregation for the Propagation of the Faith. For, when this language is once established among missionaries, it will spread at once around the world. It can be learned in several days by using it and will be of the greatest convenience in general intercourse. And, wherever it is received, there will be no difficulty in establishing the true religion which is always the most reasonable and, in a word, everything which I shall develop in my work on Catholic Demonstrations. It will be as impossible to resist its sound reasoning as it is to argue against arithmetic. You can judge what advantageous changes will follow everywhere in piety and morals and, in short, in increasing the perfection of mankind. But, to achieve this end, I shall certainly need great assistance, and I see no better source for this than the Congregation for the Propagation of the Faith, which I mentioned above.

All these projects, however, depend on the declarations from Rome, without which I could not contentedly submit, since I should otherwise be obliged to admit things which my demonstrations, and especially this characteristic, would refute in spite of myself and all the world. To obtain these declarations in the easiest way, we must undoubtedly act with great adroitness. There are many sides to everything, and the way it is first seen determines much. The most harmless proposals have often been rejected on false suspicions, and the most scabby ones accepted through the ability of their supporters. Men often do not take the pains to examine matters thoroughly, and, however acceptable views may be, they are sometimes rejected at once on a false prepossession, if they are not recommended from some quarters which are respected. This is why I have concluded that it would be well to appeal to your most serene highness, who could direct the matter so skilfully that no one could perceive anything mysterious and raise difficulties where there are no true ones. This will be all the easier, since the present pope is not only a good man, but enlightened and fair-minded as well.[267]

But there is still another outstanding reason which has obliged me to break silence and to make this proposal now. This is a most important one, and particularly concerns your serene highness. But, since I cannot blurt it out suddenly, I shall speak of it distinctly later.[268]

29

ON FREEDOM

Ca. 1679

On November 27, 1677, when he was still occupied with Spinozistic approaches to metaphysics, Leibniz had had a discussion of freedom with the apostolic missionary Steno. He had long been concerned with the problem. This paper, though undated, clearly belongs to the period of 1679 or the years following, when his position is modified by the distinction between necessary and contingent truths. It also presents a popular interpretation of some of the logical studies of the period and relates them to the theological problems of God's omnipotence, human freedom, and sin.

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[F. de C., pp. 178-85]

One of the oldest doubts of mankind concerns the question of how freedom and contingency are compatible with the chain of causes and with providence. And Christian investigations of the justice of God in accomplishing man's salvation have merely increased the difficulty of the matter.

When I considered that nothing occurs by chance or by accident unless we resort to certain particular substances, that fortune apart from fate is an empty word, and that nothing exists unless certain conditions are fulfilled from all of which together its existence at once follows, I found myself very close to the opinions of those who hold everything to be absolutely necessary; believing that when things are not subject to coercion, even though they are to necessity, there is freedom, and not distinguishing between the infallible, or what is known with certainty to be true, and the necessary.

But I was pulled back from this precipice by considering those possible things which neither are nor will be nor have been.[269] For, if certain possible things never exist, existing things cannot always be necessary; otherwise it would be impossible for other things to exist in their place, and whatever never exists would therefore be impossible. For it cannot be denied that many stories, especially those we call novels, may be regarded as possible, even if they do not actually take place in this particular sequence of the universe which God has chosen—unless someone imagines that there are certain poetic regions in the infinite extent of space and time where we might see wandering over the earth King Arthur of Great Britain, Amadis of Gaul, and the fabulous Dietrich von Bern invented by the Germans. A famous philosopher of our century does not seem to have been far from such an opinion, for he expressly affirms somewhere that matter successively receives all the forms of which it is capable (Principles of Philosophy, Part III, Art. 47).[270] This opinion cannot be defended, for it would obliterate all the beauty of the universe and any choice of matters, not to mention here other grounds on which the contrary can be shown.

Having thus recognized the contingency of things, I raised the further question of a clear concept of truth, for I had a reasonable hope of throwing some light from this upon the problem of distinguishing necessary from contingent truths. For I saw that in every true affirmative proposition, whether universal or singular, necessary or contingent, the predicate inheres in the subject or that the concept of the predicate is in some way involved in the concept of the subject. I saw too that this is the principle of infallibility for him who knows everything a priori. But this very fact seemed to increase the difficulty, for, if at any particular time the concept of the predicate inheres in the concept of the subject, how can the predicate ever be denied of the subject without contradiction or impossibility, or without destroying the subject concept? A new and unexpected light arose at last, however, where I least expected it, namely, from mathematical considerations of the nature of the infinite. For there are two labyrinths in which the human mind is caught. One concerns the composition of the continuum; the other concerns the nature of freedom. And both arise from the same source, namely, the infinite.[271] Since he could not unravel these two knots, or would not express his opinions of them, the famous philosopher whom I cited above chose to cut them with his sword, for he says (Principles of Philosophy, Part I, Arts. 40 and 41) that we can easily become involved in great difficulties if we try to reconcile God's foreordination with the freedom of the will but that we ought to refrain from such discussions because we cannot comprehend the nature of God. In the same work (Part II, Art. 35) he says that we ought not to doubt the infinite divisibility of matter, though we cannot grasp it. But this will not do, for it is one thing not to comprehend a thing, but another to comprehend its contradictory. It is therefore necessary at least to answer those arguments from which it seems to follow that freedom and the infinite divisibility of matter imply a contradiction.

It must be understood, then, that all created beings have a certain mark of the divine infinity impressed upon them and that this is the source of many wonderful matters which astound the human mind. For example, there is no portion of matter, however tiny, in which there is not a world of creatures, infinite in number. And there is no created substance, however imperfect, which does not act upon all the others and suffer action from all the others, and whose complex concept as this exists in the divine mind does not contain the whole universe, with all that ever is, has been, and will be. And there is no truth of fact or of individual things which does not depend upon an infinite series of reasons, though God alone can see everything that is in this series. This is the cause, too, why only God knows the contingent truths a priori and sees their infallibility otherwise than by experience.

A careful consideration of these matters revealed a very essential difference between necessary and contingent truths. Every truth is either original or derivative. Original truths are those for which no reason can be given; such are identities or immediate truths, which affirm the same thing of itself or deny its contrary of its contrary. There are in turn two genera of derivative truths, for some can be reduced to primary truths; the others can be reduced in an infinite progression. The former are necessary; the latter, contingent. A necessary proposition is one whose contrary implies a contradiction; such are all identities and all derivative truths reducible to identities. To this genus belong the truths said to be of metaphysical or geometrical necessity. For to demonstrate is merely, by an analysis of the terms of a proposition and the substitution of the definition, or a part of it, for the thing defined, to show a kind of equation or coincidence of predicate and subject in a reciprocal proposition, or, in other cases, at least an inclusion of the one in the other, so that what was concealed in the proposition, or was contained in it only potentially, is rendered evident or explicit by the demonstration. For example, if we understand by a ternary, a senary, and a duodenary, numbers divisible by 3, 6, and 12, respectively, we can demonstrate this proposition: Every duodenary is a senary. For every duodenary is a binary-binary-ternary, since this is the reduction of a duodenary into its prime factors (12 = 2 x 2 x 3),[272] or the definition of a duodenary. But every binary-binary-ternary is a binary-ternary (this is an identical proposition), and every binary-ternary is a senary (by the definition of a senary, since 6 = 2 x 3). Therefore every duodenary is a senary (12 is the same as 2 x 2 x 3, and 2 x 2 x 3 is divisible by 2 x 3, and 2 x 3 is the same as 6; therefore 12 is divisible by 6).

In contingent truths, however, though the predicate inheres in the subject, we can never demonstrate this, nor can the proposition ever be reduced to an equation or an identity, but the analysis proceeds to infinity, only God being able to see, not the end of the analysis indeed, since there is no end, but[273] the nexus of terms or the inclusion of the predicate in the subject, since he sees everything which is in the series. Indeed, this truth itself arises in part from his intellect and in part from his will and so expresses his infinite perfection and the harmony of the entire series of things, each in its own particular way.

For us, however, there remain two ways of knowing contingent truths. The one is experience; the other, reason. We know by experience when we perceive a thing distinctly enough by our senses; by reason, however, when we use the general principle that nothing happens without a reason, or that the predicate always inheres in the subject by virtue of some reason. So we can consider it as certain that God has made all things in the most perfect way, that he does nothing without a reason, and that nothing ever happens without its reason being understood by anyone who understands why the state of the world is as it is rather than otherwise. Sins arise from the aboriginal limitation of things; but God does not so much decree sins as he does the admission to existence of certain possible substances whose complete concept already involves the possibility of their freely sinning, and even connotes the whole series of events in which they figure as links. Nor should there be any doubt that God decrees only perfection or what is positive, while limitation arises from perfection, and sin is permitted only because it cannot be absolutely rejected if certain positive decrees are maintained. Nothing else would be congruent with wisdom than to compensate sin by a greater good that could not otherwise be obtained; but this cannot be discussed here.

In order to fix our attention, however, so that our mind will not wrestle with vague difficulties, an analogy comes to my mind between truths and proportions which seems admirably to clarify the whole matter and put it in a clear light. Just as the smaller number is contained in the larger in every proportion[274] (or an equal in its equal), so in every truth the predicate is contained in the subject. And just as in every proportion between homogeneous quantities an analysis of equal or proportional terms can be carried out by subtracting the smaller from the larger, that is, taking away from the larger a part equal to the smaller, then subtracting the rest from the smaller, and so on, either until there is no remainder or to infinity; so also can we establish an analysis of truths, always substituting for a term its equivalent, so that the predicate will be resolved into elements already contained in the subject. But in proportions the analysis may sometimes be completed, so that we arrive at a common measure which is contained in both terms of the proportion an integral number of times, while sometimes the analysis can be continued into infinity, as when comparing a rational number with a surd; for instance, the side of a square with the diagonal.[275] Just so, truths are sometimes demonstrable or necessary, and sometimes free and contingent, so that they cannot be reduced to identities as if to a common measure, by any analysis. This is the essential distinction between truths as well as proportions.

Yet the science of geometry has mastered incommensurable proportions, and we have demonstrations even about infinite series. All the more are contingent or infinite truths subject to the knowledge of God and known by him, not by demonstration—for this would involve contradiction—but by an infallible vision. But this vision of God must not be thought of as a kind of empirical knowledge, as if he saw anything in the things distinct from himself, but as a priori knowledge in which he grasps the reasons for truths. For he sees possible things by considering his own essence; he sees those that have a contingent existence by considering his free will and his decrees, the first of which is that everything shall work in the best manner and with the highest reason. The so-called middle science is nothing but the knowledge of contingent possibles.[276]

When all these matters are considered thoroughly, I do not think any difficulty can arise in this argument the solution of which cannot be derived from what has been said. If we admit this general concept of necessity—and everyone does admit it—namely, that all propositions are necessary whose contraries imply a contradiction, it is easily seen from a consideration of the nature of demonstration and analysis that there can and must be truths which cannot be reduced by any analysis to identities or to the principle of contradiction but which involve an infinite series of reasons which only God can see through. This is the nature of everything which is called free and contingent and especially of everything which involves space and time. As I have shown above, this follows from the very infinity of the parts of the universe and the mutual interdependence and nexus of all things.

30

"First Truths"

Ca. 1680-84

Among the papers of the period from 1679 to 1686 is this very important one, usually designated by its opening words, primae veritates, which Couturat has used to support his argument for the essentially logical foundation of Leibniz's metaphysics.[277] The student will discover, however, that though the principles of metaphysics, including that of individuality, are here developed a priori, the paper moves by means of definitions from an abstract principle of identity to more complete concepts and more concrete principles. Many of these definitions are basically metaphysical in character.

The date is unknown. On the one hand, there are only references to the distinction between truths of reason and of fact and between necessity and contingency, a distinction developed in detail in No. 29. On the other hand, the concepts and phrases of the Discourse of 1686 (No. 34) are already prominent, and Couturat considered it a forestudy for that work.

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[Cout. OF., pp. 518-23]

First truths are those which predicate something of itself or deny the opposite of its opposite. For example, A is A, or A is not non-A; if it is true that A is B, it is false that A is not B or that A is non-B. Likewise, everything is what it is; everything is similar or equal to itself; nothing is greater or less than itself. These and other truths of this kind, though they may have various degrees of priority, can nevertheless all be grouped under the one name of identities.

All other truths are reduced to first truths with the aid of definitions or by the analysis of concepts; in this consists proof a priori, which is independent of experience.[278] I shall give as example this proposition which is accepted as an axiom by mathematicians and all other people alike: the whole is greater than its part, or the part is less than the whole. This is very easily demonstrated from the definition of less or greater, with the addition of a primitive axiom or identity. For that is less which is equal to a part of another thing (the greater). This definition is very easily understood and is consistent with the general practice of men, when they compare things with each other and measure the excess by subtracting an amount equal to the smaller from the greater. Hence one may reason as follows. A part is equal to a part of the whole (namely, to itself, by the axiom of identity, according to which each thing is equal to itself). But what is equal to a part of a whole is less than the whole (by the definition of less). Therefore the part is less than the whole.

The predicate or consequent therefore always inheres in the subject or antecedent. And as Aristotle, too, observed, the nature of truth in general or the connection between the terms of a proposition consists in this fact.[279] In identities this connection and the inclusion of the predicate in the subject are explicit; in all other propositions they are implied and must be revealed through the analysis of the concepts, which constitutes a demonstration a priori.

This is true, moreover, in every affirmative truth, universal or singular, necessary or contingent, whether its terms are intrinsic or extrinsic denominations.[280] Here lies hidden a wonderful secret which contains the nature of contingency or the essential distinction between necessary and contingent truths and which removes the difficulty involved in a fatal necessity determining even free things.

These matters have not been adequately considered because they are too easy, but there follow from them many things of great importance. At once they give rise to the accepted axiom that there is nothing without a reason, or no effect without a cause. Otherwise there would be truth which could not be proved a priori or resolved into identities—contrary to the nature of truth, which is always either expressly or implicitly identical.[281] It follows also that, if there is a correspondence between two data in a determining series, then there will also be a correspondence of the same kind in the series sought for and determined by the former. For no difference can be accounted for unless its reason is found in the data.[282] A corollary, or, better, an example, of this is the postulate of Archimedes stated at the beginning of his book on the balance—that if the arms of a balance and its weights are supposed equal, everything will be in equilibrium. This also gives a reason for eternal things. If it be assumed that the world has existed from eternity and has contained only spheres, a reason should have to be given why it contains spheres rather than cubes.

It follows also that there are no two individual things in nature which differ only numerically. For surely it must be possible to give a reason why they are different, and this must be sought in some differences within themselves. Thus the observation of Thomas Aquinas about separate intelligences, which he declared never differ in number alone, must be applied to other things also.[283] Never are two eggs, two leaves, or two blades of grass in a garden to be found exactly similar to each other. So perfect similarity occurs only in incomplete and abstract concepts, where matters are conceived, not in their totality but according to a certain single viewpoint, as when we consider only figures and neglect the figured matter. So geometry is right in studying similar triangles, even though two perfectly similar material triangles are never found. And, although gold or some other metal, or salt, and many liquids, may be taken for homogeneous bodies, this can be admitted only as concerns the senses and not as if it were true in an exact sense.

It follows further that there are no purely extrinsic denomi-

nations which have no basis at all in the denominated thing itself. For the concept of the denominated subject necessarily involves the concept of the predicate. Likewise, whenever the denomination of a thing is changed, some variation has to occur in the thing itself.

The complete or perfect concept of an individual substance involves all its predicates, past, present, and future. For certainly it is already true now that a future predicate will be a predicate in the future, and so it is contained in the concept of the thing. Therefore there is contained in the perfect individual concepts of Peter or Judas, considered as merely possible concepts and setting aside the divine decree to create them, everything that will happen to them, whether necessarily or freely. And all this is known by God. Thus it is obvious that God elects from an infinity of possible individuals those whom he judges best suited to the supreme and secret ends of his wisdom. In an exact sense, he does not decree that Peter should sin or Judas be damned but only that, in preference to other possible individuals, Peter, who will sin—certainly, indeed, yet not necessarily but freely—and Judas, who will suffer damnation—under the same condition—shall come into existence, or that the possible concept shall become actual. And although the eternal possible concept of Peter also contains his future salvation, the cooperation of grace is not yet absent from it, for this same perfect concept of this possible Peter also contains as a possibility the help of divine grace which will be granted to him.

Every individual substance involves the whole universe in its perfect concept, and all that exists in the universe has existed or will exist. For there is no thing upon which some true denomination, at least of comparison or relation, cannot be imposed by another thing. Yet there is no purely extrinsic denomination.[284] I have shown the same thing in many other ways which are in harmony with each other.

All individual created substances, indeed, are different expressions of the same universe and of the same universal cause, God. But these expressions vary in perfection as do different representations or perspectives of the same city seen from different points.

Every created individual substance exerts physical action and passion on all others. For if a change occurs in one, some corresponding change results in all others, because their denomination is changed. This is confirmed by our experience of nature, for we observe that in a vessel full of liquid (the whole universe is such a vessel) a motion made in the middle is propagated to the edges, though it may become more and more insensible as it recedes farther from its origin.

It can be said that, speaking with metaphysical rigor, *no created substance exerts a metaphysical action or influence upon another*. For to say nothing of the fact that it cannot be explained how anything can pass over from one thing into the substance of another, it has already been shown that all the future states of each thing follow from its own concept. What we call causes are in metaphysical rigor only concomitant requisites. This is illustrated by our experiences of nature, for bodies in fact recede from other bodies by force of their own elasticity and not by any alien force, although another body has been required to set the elasticity (which arises from something intrinsic to the body itself) working.[285]

If the diversity of soul and body be assumed, their union can be explained from this without the common hypothesis of an *influx*, which is unintelligible, and without the hypothesis of occasional causes, which calls upon a God *ex machina*. For God has equipped both soul and body from the beginning with such great wisdom and workmanship that, through the original constitution and essence of each, everything which happens in one corresponds perfectly and automatically to whatever happens in the other, just as if something had passed over from the one into the other. I call this the *hypothesis of concomitance*. This is true of all the substances in the whole universe but is not perceptible in all as it is in the soul and body.

There is no vacuum. For the different parts of empty space would be perfectly similar and congruent with each other and could not by themselves be distinguished. So they would differ in number alone, which is absurd. Time too may be proved not to be a thing, in the same way as space.

There is no corporeal substance in which there is nothing but extension, or magnitude, figure, and their variations. For otherwise there could exist two corporeal substances perfectly similar to each other, which is absurd. Hence it follows that there is something in corporeal substances analogous to the soul, which is commonly called form.[286]

There are no atoms; indeed, there is no body so small that it is not actually subdivided. By this very fact, since it is affected by all other things in the entire world, and receives some effect from all which must cause a change in the body, it has even preserved all past impressions and anticipates the future ones. If anyone says that this effect is contained in the motions impressed on the atom, which receives the effect in toto without any division in it, it can be replied that not only must an effect in the atom result from all the impressions of the universe but, conversely, the entire state of the universe can be gathered from the atom. Thus the cause can be inferred from the effect. But, from the figure and motion of the atom alone, we cannot by regression infer what impressions have produced the given effect on it, since the same motion can be caused by different impressions, not to mention the fact that we cannot explain why bodies of a definite smallness should not be further divisible.

Hence it follows that every small part of the universe contains a world with an infinite number of creatures. But a continuum is not divisible into points, nor is it divisible in all possible ways. It is not divisible into points, because points are not parts but limits. It is not divisible in all possible ways, because not all creatures are in the same part; yet it is certain that the parts are infinitely divisible. Thus, if you bisect a straight line and then any part of it, you will set up different divisions than if you trisect it.

There is no actual determinate figure in things, for none can satisfy the infinity of impressions. So neither a circle nor an ellipse nor any other line is definable by us except in our intellect, or, if you prefer, before the lines are drawn or their parts distinguished.[287]

Space, time, extension, and motion are not things but well-founded modes of our consideration.

Extension, motion, and bodies themselves, insofar as they consist in extension and motion alone, are not substances but true phenomena, like rainbows and parhelia. For figures do not define things, and, if only their extension is considered, bodies are not one substance but many.

For the substance of bodies there is required something which lacks extension; otherwise there would be no principle to account for the reality of the phenomena or for true unity. There would always be a plurality of bodies, never one body alone; and therefore there could not, in truth, be many. By a similar argument Cordemoi proved the existence of atoms. But, since these have been excluded, there remains only something that lacks extension, something like the soul, which was once called a form or species.[288]

Corporeal substance can neither come into being nor perish except through creation or annihilation. For, once it does last, it will last always, for there is no reason for a change. Nor does the dissolution of a body have anything in common with its destruction. Therefore ensouled beings neither begin nor perish; they are only transformed.

31

Selections from Leibniz's Correspondence

1679-84

The reign of Ernest August and his wife Sophia, 1680-97, was a period of aggressive political advancement for the Duchy of Hanover. Within the Empire it was elevated to an electorate. Marriage alliances with Celle, Prussia, Austria, and Modena shifted and strengthened political ties. Plans were laid in behalf of Sophia for the English succession. In the promotion of these aims Leibniz's efforts, too, were distracted from his intellectual projects and largely absorbed in the historical studies, diplomatic briefs, and efforts for church union which were involved in the ambitions of his patrons. In the years from 1681 to 1685 he was also engaged in the unsuccessful engineering project of freeing the Harz silver mines of excess water.

The following selections are from his wide correspondence with scholars and men of affairs. They contain criticisms of the thought of others and reflect his efforts to gain general and influential support for his own ideas.

* * *

I

To Christian Philipp[289]

[G., IV, 281-82]

Early December, 1679

As concerns the philosophy of Descartes, about which you ask my opinion, I hesitate to say absolutely that it leads to atheism. It is true that he says some things which I, who have studied him thoroughly, strongly suspect. For example, the two passages to the effect that one should not consider final causes in physics and that matter takes on, successively, all the forms of which it is capable.[290] There is an admirable passage in Plato's Phaedo in which he justly blames Anaxagoras for the same thing which displeases me in Mr. Descartes.[291] For my part, I believe that the laws of mechanics which serve as foundation for the whole system depend on final causes, that is to say, on the will of God determined to do what is most perfect, and that matter takes on not all possible forms but only the most perfect ones. Otherwise we should have to say that there will be a time in which everything will be badly ordered, which is far removed from the perfection of the Author of all things. For the rest, if Descartes had relied less on his imaginary hypotheses and been more attached to experience, I believe that his physics would have been worth following, for it must be admitted that he had great penetration. As for his geometry and analysis, it is far from being as perfect as is claimed by those who have only applied themselves to the solution of minor problems. There are several errors in his metaphysics, and he did not know the genuine source of truths or the general analysis of concepts. In my opinion Jung understood this better than did he.[292] Yet I admit that it is very useful and instructive to read Descartes, and I prefer, beyond comparison, to deal with a Cartesian rather than with a partisan of some other school. In short, I consider this philosophy as the antechamber to the true one.

II

To Philipp

[G., IV, 283-84]

End of January, 1680

. . . I esteem Mr. Descartes almost as much as one can esteem any man, and, though there are among his opinions some which seem false to me, and even dangerous, this does not keep me from saying that we owe nearly as much to Galileo and to him in philosophical matters as to the whole of antiquity. At present I recall only one of the two dangerous propositions, the location of which you want me to indicate. It is in the Principles of Philosophy, Part III, Article 47, in the following words:

> And, after all, it makes very little difference what we assume in this respect, because it must later be changed according to the laws of nature. Hardly anything can be assumed from which the same effect cannot be derived, though perhaps with greater trouble. For, due to these laws, matter takes on, successively, all the forms of which it is capable. Therefore if we considered these forms in order, we could eventually arrive at that one which is our present world, so that in this respect no false hypothesis can lead us into error.

I do not believe that a more dangerous proposition than this could be formulated. For if matter takes on, successively, all possible forms, it follows that nothing can be imagined so absurd, so bizarre, so contrary to what we call justice, that it would not have happened and will not some day happen. These are precisely the opinions which Spinoza has expounded more clearly, namely, that justice, beauty, and order are things merely relative to us but that the perfection of God consists in that magnitude of his activity by virtue of which nothing is possible or conceivable which he does not actually produce. These are also the opinions of Mr. Hobbes, who asserts that everything that is possible is either past or present or future, and there will be no place for trust in providence if God produces everything and makes no choice among possible beings. Mr. Descartes was careful not to speak so plainly, but he could not keep from revealing his opinions incidentally, with such adroitness that he will be understood only by those who examine such matters carefully. In my opinion, this is the "first falsehood" and the basis of atheistic philosophy, though it always seems to say the most beautiful things about God. The true philosophy, on the contrary, must give us an entirely different concept of God's perfection, one that will be of use in both physics and ethics. For my part, I hold that far from excluding final causes from physics, as Mr. Descartes tries to do in Part I, Article 28, it is rather by means of them that everything must be determined, since the efficient cause of things is intelligent, having a will and therefore striving for the good. But this too differs from Descartes's opinion, since goodness, truth, and justice are such, according to him, only because God has established them by a free act of his will—a most strange thing. For if things are good or evil only as the result of God's will, the good cannot be a motive of his will, being posterior to his will. His will, then, would be a certain absolute decree, without any reason. . . .[293]

III

To François de la Chaise[294]

[PA., II, i, 511-12]

May, 1680(?)

Most reverend Father,

I have always contemplated an art of discovery, and I believe I have made most unusual beginnings toward it. Algebra is but one example of it. I have a new kind of geometry as different from Mr. Descartes's as his is from the geometry of the ancients. For as Descartes has added supersolid lines and problems, or even problems of the fifth, sixth, seventh, and higher degrees to the plane and solid lines and problems of the ancients, so I have added transcendental problems which are of no degree, or rather of all degrees at once, to his. Of this kind is the cutting of an angle in a given ratio, or also the trigonometry without tables which I have, as well as the true area of a circle in rational numbers. This is $\frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} +$, etc., when the diameter or its square is 1. It is impossible to give the area in a single number, but this is its true value and contains at once all the approximations to it. I believe that men will now stop the useless effort to find the true ratio, which is none other than this. When the nicest problems of mechanics are reduced to the terms of pure geometry,[295] one will usually find a transcendental problem where the geometry of Descartes is insufficient. I can give numberless examples of this.

Until now the problems of mechanics could not be reduced to those of pure geometry, for the laws of motion had not been fixed. Now I have found a way of determining them all by a reductio ad absurdum. I demonstrate the rules of motion, in the same way that geometricians demonstrate their theorems, by showing that the contrary would imply that a thing is greater than itself; I show that to assume the contrary would make a thing more powerful than itself, that is to say, it would be possible to establish purely mechanical perpetual motion.[296] By this same method I demonstrate that Mr. Descartes's rules of motion are impossible. I believe that it can now be said that we have at last achieved pure mathematics, that is, mathematics which contains only numbers, figures, and motions; the rest will be a mere exercise for youngsters in developing their reason. For posterity there will remain only the task of turning its serious attention to physics. Perhaps we could also go much further in medicine, even in our own time, if we were to attack it in a better way. It depends only on a great king, like your own, to achieve this. For it seems to me that there is an analysis in physics as certain as that in geometry, not for the purpose of determining what experiments are fitting—for that is where chance plays a part, though one could still perform the proposed experiments by this method—but to draw from given experiments everything that an angelic spirit could draw from them and to determine those which remain to be made in order to resolve our doubts.

I am greatly surprised that those who are called Cartesians have done almost nothing since the death of their master, who was undoubtedly a great man, though not as great as they think. Having considered everything, I find that we should retain the philosophy of Aristotle, St. Thomas, and that taught in your society: namely, that there are substantial forms and that the nature of body consists, not in extension, but in an action which is related to the extended, for I hold that there can be no body without effort. It follows from this that non corpus necessario determinatae extensionis esse sed ad eam habendam inclinari nisi superior potentia impediat.[297] If explained reasonably, this is in perfect agreement with the common philosophy, and the mystery of the Eucharist can be supported by it admirably. Those who believe that there is no difference between body and extension cannot defend this doctrine, though they say that the same body can be in many places.

I am having my arithmetical machine worked on. It is entirely different from Pascal's and from the sticks of Napier. . . . At present I am very busy, working out something that will succeed in drawing the water from our mines in the Harz. . . .

IV

To Veit Ludwig von Seckendorf[298]

[PA., II, i, 533]

June 1/11, 1683

. . . Since you mention Blaise Pascal and Peter Daniel Huet,[299] whose writings in defense of religion deserve praise, I shall tell you some things which I have learned about them. I have often spoken with Huet and saw his work when it existed only in manuscript; I have since received letters from him here in Germany. Pascal had recently died when I lived in Paris, but his sister was there, a learned and clever woman, and also his nephews, the sons of his sister.[300] I had many associations with them, as well as with the illustrious Duke de Roannez, who had been a close associate of Pascal's and had been much influenced by these studies. From them I received some of Pascal's unpublished works to read, though they were mostly mathematical. I also learned some things about his life and the brilliant plans which he pursued for the propagation of piety; these I shall be able to relate more fully elsewhere. I will say one thing. Pascal paid attention only to moral arguments, such as he excellently presented in his little posthumous book of Thoughts, but he did not put much value on the metaphysical arguments which Plato and St. Thomas, and other philosophers and theologians, have used in proving the divine existence and the immortality of the soul. In this I do not agree with him. I think that God speaks to us, not merely in sacred and civil history, or even in natural history, but also internally, within our mind, through truths which abstract from matter and are eternal. Even if I should confess that these arguments have not been carried to the full force of a complete demonstration, they already seem to have as much force as the moral arguments; and I believe that men will gradually perfect them and that sometime, perhaps, they can be reduced to a rigorous demonstration. So I think we should disdain nothing which can be of use to us, even if all things are not useful to all men, and that each one should use those things rightly which best fit his own purpose.

I do not think that Huet followed Pascal's Thoughts but that he anticipated their publication a long time in preparing his own work. His preface, if I am not mistaken, hints at nothing else, and since the whole basis of his work is his proof that the prophecies have been fulfilled in Jesus Christ—arguments which the apostles themselves had already used but which he enriched with great learning and his many brilliant observations—I do not see how he can well be said to have followed Pascal.

V

To Walter von Tschirnhaus

[PA., II, i, 541-42]

November (?), 1684

. . . In Holland they are now disputing, loudly and soundly, whether beasts are machines. People are even amusing themselves by ridiculing the Cartesians for imagining that a dog that is clubbed cries in the same way as a bagpipe which is pressed. As for me, though I grant the Cartesians that all external actions of beasts can be explained mechanically, I nevertheless believe that beasts have some knowledge and that there is something in them, not itself extended, which can be called a soul, or, if you prefer, a substantial form. . . .

. . . I am astonished that Mr. Arnauld and Mr. Malebranche, who were such good friends when I was in Paris, are now attacking each other in their writings.[301] I have not yet read the books they have directed against each other, but, so far as I can judge by their other works, Father Malebranche has much spirit but Mr. Arnauld writes with more judgment. There are many nice thoughts in the Recherche de la vérité, but the author is far from having penetrated very deeply into analysis and the art of discovery in general. I could not help laughing when I saw that he thinks that algebra is the first and most sublime science and that truth is nothing but a relation of equality and inequality; that arithmetic and algebra are the only sciences which give the mind all the perfection and extension of which it is capable; and, finally, that arithmetic and algebra together are the true logic. Yet I do not see that he himself has a great knowledge of algebra. The praise he bestows upon it should be given to symbolics in general, of which algebra is only a very particular and limited example.

32

ON THE ELEMENTS OF NATURAL SCIENCE[302]

Ca. 1682-84

Nearly fifty years ago Ernst Gerland published what was obviously a preliminary plan made by Leibniz in his early years at Hanover for a small work entitled the *Elementa physicae* (Ger., pp. 110-13). In a note Gerland expressed regret that Leibniz did not pursue this project, which promised so much. He seems not to have observed that the folder of ten folio sheets of manuscript at Hanover among which he found the plan contained an extensive draft of a proposed popular introduction to the work, which was obviously intended for the two projects toward which he worked for so long—the encyclopedia and the *Catholic Demonstrations*.[303] We here offer translations of the prospectus published by Gerland (I) and of the Introduction (II), which is concerned with the human values of science and an account of the method of analysis and synthesis as it is used in the investigation of corporeal phenomena. As such it may well be regarded, not merely as one of the earliest attempts to give a popular introduction to science, but as a realistic companion piece to Nos. 25 and 33, with an objective reference to things and their attributes rather than to ideas. Leibniz's account of the significance of physical science is still timely. The influence of Francis Bacon, and particularly of Robert Boyle, is obvious.

Both parts are here translated from the manuscript in Hanover; the Introduction has not yet been published in the original Latin.

* * *

I

The Plan of the Book

[Bod. LH., XXXVII, iv, 9-10]

A small book is to be written on the Elements of Natural Science. To it may be added a description of phosphorus [pyropum], i.e., of the noctiluca which is a fire which does not consume and at the same time needs no fuel.[304]

Our natural science will deal not with observations or a description[305] of nature but with principles [rationes] or with qualities and with what follows from the principles necessarily or with certainty per se (that is, if nothing impedes them). For only later will it be necessary to apply these reasonings to observations. The first part will therefore deal with qualities, but the second will deal with the subjects of qualities or with bodies which exist in the world, where description is combined with reasoning. Thus we shall deal with body and with its qualities, both the intelligible ones which we conceive distinctly and the sensible ones which we perceive confusedly.[306]

A body is extended, mobile, and resistant; that is, it is that which can act and suffer insofar as it is extended—acting when it is in motion, suffering when it resists motion. There are thus to be considered, first, extension; next, motion; and, third, resistance or impact.

Extended is what has size and situation [situs]. Size is the mode by which all the parts of a thing, or all the entities by means of which the thing can be understood, are determined. Situation is the mode of determining with which qualities a thing can be perceived.

The size of a thing is known exactly when the number of its parts is known which are congruent with some given measure. We must therefore deal with numbers, both with those that are definite or defined and which belong to arithmetic and those which are indefinite, belonging to algebra. Here we shall deal with equality and ratio. For those things are equal which can be made congruent, and ratio is to equality as numbers are to unity.

The situation of parts among themselves is called figure. From this can be derived similars, which can be distinguished only if they are perceived together. Homogeneous things, however, are those which can be reduced to similars. All things that are similar and equal are congruent.[307]

Before dealing with figure, we must deal with space itself and with the point; with the sphere and the intersection of two spheres or the circle; with the plane and the intersection of two planes or the straight line; with the intersection of three spheres or the point. From this it is clear why the locus of a point is given if its distance from three other points is given, and a plane besides, since three spheres can intersect in two points. Thus we shall also find the nature of a straight line and why two straight lines cannot have only two points in common. Thus a demonstration of the Elements [of Geometry] will now be easy. And so far this will involve a consideration of figures without any recourse to motion.[308]

There follows then motion or change of situation; here the method of generating the circle and the straight line. Here we shall explicate the tornatorial science, or the science of the traces of motions.[309] On the method of getting a straight line, a plane, a sphere, a cone, the conic sections and their delineations on a plane; on still more complex figures; on the varied composition of motions.

On impact or on motion and resistance combined. Here we deal with various machines, wheels, and vessels.[310]

It is then to be demonstrated that space is indefinitely extended, for there can be no reason why it should end anywhere, because whatever can be concluded about any particular thing can likewise be concluded about anything similar to it. So one can conclude about a greater circle only what has already been concluded about a smaller. It is therefore impossible to designate any sphere beyond which no space exists. For, if there were any reason for such a sphere, the same reason would be correspondingly valid for all other spheres. God, however, does nothing without reason.

It is to be demonstrated also that every body is actually divided into smaller parts, or that there are no atoms, and that no actual continuum can be pointed out in any body. From the nature of this division arise fluidity and firmness. Empty space can in no way be distinguished from the perfectly fluid. There is no perfectly fluid body. There is no vacuum. In introducing his subtle matter, Descartes has done away with the vacuum in name only.

There follows now a discussion of incorporeal matters. Certain things take place in a body which cannot be explained from the necessity of matter alone. Such are the laws of motion, which depend upon the metaphysical principle of the equality of cause and effect. Therefore we must deal here with the soul and show that all things are animated. Without soul or form of some kind, body would have no being, because no part of it can be designated which does not in turn consist of more parts. Thus nothing could be designated in a body which could be called "this thing," or a unity. On the nature of soul or form; that there is a kind of perception and appetite which are the passions and actions of the soul. And why; because souls result from God's knowledge of things, or they are imitations of the ideas. All souls are indestructible, but those especially are immortal which are citizens in the commonwealth of the universe, or those to whom God is not merely author but also king, for to them he is connected by an entirely special basis, and they are therefore called minds. These minds never forget themselves. They alone think of God and have distinct conceptions of things. It is improper to try to ascribe perception to man alone. Since all bodies are able to have some perception according to the measure of their perfection, they will have it, for whatever can happen without detriment to other things will in fact happen, because everything occurs in the most perfect way. Here too can be explained the nature of joy and grief, which is merely the perception of one's own success or perfection. Thus when a striving [conatus] is satisfied, the result is success; when it meets resistance, there arises grief. There are as many mirrors of the universe as there are minds, for every mind perceives the whole universe, but confusedly.

Next we must deal with force or power. Here it must be recognized that it is to be estimated from the quantity of its effect. But the power of the effect and of the cause are equal to each other, for, if the effect were greater, we should have mechanical perpetual motion, while, if it were less, we should not have perpetual physical motion. It is worth showing here that the same quantity of motion cannot be conserved but that the same quantity of power is. Yet we must see whether there will not also be conserved in the universe the same quantity of motion also.[311]

On perturbations and restitutions; on the reciprocal adjustments arising from these. On the isochronic adjustments of balances and of all kinds. That the times are thus proportional to the forces. In every machine or composite structure the power tends at a constant ratio toward restitution.

On weight or the solidity of a body and on the center of gravity. It is shown that there is a center of gravity in every body.

On elastic force. On magnetic force. On impacts and reflections.

On degrees of firmness; on fluid, rigid, flexible, tenacious bodies. On the motion of a solid in a fluid.

On refraction in the transition from one fluid to another. All things seem in fact to be fluid but merely variously folded into each other without a break in the continuity.

On what follows from certain definite laws of reflection and refraction.[312] On tense bodies and their pulsations and vibrations.

On a fluid within a fluid; a fluid within a solid which it cannot escape; a fluid outside a solid which it cannot enter; a permeating fluid.

On an elastic fluid and the propagation of vibrations in it; and on bodies emitting the same tones.

We must treat of meteors, crystals, and other bodily configurations.[313]

It will be best to postpone the details of definition and demonstration a little and to explain everything continuously and in clear language. So we will proceed as follows:

Since our happiness consists in the perfection of the mind, but our mind is in this life affected in various ways by its body, and the human body is brought to enjoy and to suffer by other environing bodies, it follows that to know the nature of bodies should be considered a large part of wisdom, to the end that we may avoid their harmful, but experience their friendly, force. . . .

II

An Introduction on the Value and Method of Natural Science

[LHS, XXXVII, iv, 1-6]

On the utility of natural science.

Every science is to be sought after, not for the sake of curiosity or ostentation, but for the sake of action. However, we act to attain happiness or a state of enduring joy, and joy is the sense of perfection. Every thing is to be held as more perfect to the degree that it is freer by nature; that is, to the degree that its power is greater over the things that surround it, and its suffering from external things is less. Hence, since the power proper to the mind is understanding, it follows that we will be the happier the clearer our comprehension of things and the more we act in accordance with our proper nature, namely, reason. Only to the extent that our reasonings are right are we free, and exempt from the passions which are impressed upon us by surrounding bodies. Yet it is impossible to evade these passions entirely, since the mind is affected in various ways by its body, while our body, which is but a small part of the universe, can be helped and harmed by the bodies which surround it. The knowledge of bodies is therefore most important on two grounds—first, to perfect our mind through an understanding of the purposes and causes of things; second, to conserve and nurture our body, which is the organ of the soul, by furthering what is wholesome for it and reducing what is harmful.

The greatest usefulness of theoretical natural science, which deals with the causes and purposes of things, is for the perfection of the mind and the worship of God.

Of these two applications of this science, the former can be sought only in theoretical physics, the latter in empirical physics as well. For if a person should by accident or tradition secure a very important and useful secret of nature, such as the tincture of metals now being praised by so many authors, but did not understand its causes, he might be externally richer for it but not happier or wiser unless he used it to attain freedom of mind. But if someone were to discover some admirable device of nature and to learn its mode of operation, he would have achieved something great even if no application of his discovery to common life could be shown. For though all science increases our power over external things provided a proper occasion arises for using it, there is nonetheless another use which depends on no such occasion, namely, the perfection of the mind itself. By understanding the laws or the mechanisms of divine invention, we shall perfect ourselves far more than by merely following the constructions accepted by men. For what greater master can we find than God, the author of the universe? And what more beautiful hymn can we sing to him than one in which the witness of things themselves expresses his praise?[314] But, the more one can give reasons for his love, the more one loves God. To find joy in the perfection of another—this is the essence of love. Thus the noble function of our mind is the knowledge or, what is here the same thing, the love of the most perfect being, and it is from this that the maximum or the most enduring joy, that is, felicity, must arise. Nor should we think that anything is badly arranged in the universe or that God neglects those who honor him. But the proper place to show this more fully is in another science. It must be mentioned, however, lest, as sometimes happens, the most important application of theoretical physics be neglected.

Empirical physics is useful for human life and should be cultivated in the state.

The other use, which applies to our common life, is shared by theoretical and empirical physical science. For if we have a so-called specific remedy for an illness but are ignorant of its mode of action, we may nonetheless be cured by it. Most of the things, however, which are required for the effective conduct of life men have derived from experience; such are the use of fire and water; the separation of metals from their ores through melting, so that they can be shaped when hot but become firm when cold; the power of the earth to put forth plants from seeds; the hunting, taming, and breeding of animals; the difference between poisonous and wholesome foods; clothing and shelter; and, finally, men's communication with each other, without which this life would be wretched and bestial. Thus human societies have come into being and duties have been distributed, some administering public affairs, others using certain specific skills through which the common need is alleviated through the collection, preparation, and distribution of material things. Thus physical science has always been regarded most highly in the state, and those who taught men how to sow and to plant vines were in antiquity superstitiously placed among the gods. Today the wisest princes offer rewards to discoverers and inventors, and deservedly so, for sometimes one small observation will cause whole cities and provinces to flourish. As an example may be given the cultivation of silk, introduced a few centuries ago into Italy and more recently in France, yet from which so many thousands of men live. The first man to cook alum in Europe should also be mentioned, this skill having been brought in from Rocca in Syria; and whoever first showed that herring could be preserved with salt, a most profitable discovery for the Belgians. Surely there is scarcely any handicraft which does not rest upon some individual observation of nature. I believe too that many things are known to some people, for which, if others knew them, an application could at once be found to a variety of crafts.

A catalogue of experiments is to be compiled.

Thus it is a concern of the state to publish the observations with which only a few are concerned and which very often seem to the scientists themselves to be of no use, by setting up a history of nature in which experiments will be brought together in a catalogue. One who deals with only a limited field rarely discovers anything new, since he soon exhausts his subject. But from those who investigate many different things and are gifted with a combinatorial genius we may expect many new and useful interconnections of things. If men would now undertake such an inventory of experiments, a fertile field would be prepared for new discoveries in all sciences and industries. Men endowed with judgment and industry should thus be appointed to select, verify, order, and classify by means of various indices those experiments which are already known to mankind, whether put down in writing or merely preserved in some tradition. It seems that the emperors of Constantinople long ago undertook something of this kind in all fields of science, but, though we have some collected facts and excerpts coming from their times, they are not adequate for the purpose of scholarship.

New experiments are to be undertaken at public expense, and only men outstanding not merely in science but in virtue are to be placed in charge.

Yet many experiments of great importance are still quite dubious and full of errors. Also, men of genius could propose many that are still to be undertaken. It follows that laboratories must be set up at various places by public authority, along with depositories for machines and collections of exotic materials [exoticophylaciis],[315] in which the varied wonders of nature and of art can be both observed and tested. Here everyone will be free to make trial of his genius at public expense, provided only that he has secured from just judges an approval of his plan. To these are to be added zoölogical gardens and hospitals. From physicians, hunters, workmen, and foreigners who have an opportunity to learn many things, faithful accounts must be demanded. Rewards must be set up for industrious achievement. But the main thing, the observance of which assures that great things will be achieved with small outlay, but whose neglect will make even the greatest expenditures futile, is this: men must be chosen and placed at the head of this business who not only are outstanding in ability, judgment, and learning but also are endowed with a unique goodness of mind; in whom rivalry and jealousy are wanting; who will not use despicable devices to appropriate for themselves the labors of others; who are not factious and have no wish to be regarded as the founders of sects; who labor for love of learning itself and not for ambition or sordid pay. Such men will certainly become friends and will push forward the laudable undertakings of others, thus deserving much from mankind. The great Mersenne was a man of this kind long ago, and I should prefer that these men today should fall behind him a little in science rather than in probity.[316]

With the experiments are to be combined accurate and thoroughly extended reasonings after the manner of geometry, for only in this way can causes be discovered.

Yet the most outstanding experiments are in vain if men who will use them are lacking. The utility of experiments is of two kinds: one for the varied conveniences of life, which are revealed by reasoning from cause to effect; the other to bring to light true principles, by proceeding from effect to causes. Each way of reasoning may be either combinatorial or analytic. The former method, namely, the combinatorial, consists of a kind of simple reflection, and, once one has it pointed out to him by a single word, he understands it at once and wonders why the same thing had not occurred to him. Such a case is the invention of the mortar after gunpowder was already known or the invention of the chronometer after the equality of pendulum vibrations was known. The latter method is connected in a longer chain of reasons and involves a kind of geometry or calculus and cannot be understood without much thought. Such is the discovery of the curve which controls the unequal vibrations of pendulums.

The former mode, as I have already said, will be ready for men of ability when once we have an inventory of experiments, because a multitude of applications to various uses and works of craftsmanship will occur to those who study this inventory. But the discovery of causes, without which we cannot hope for great advances in the most urgent field of physical science, namely, medicine, can be obtained not through such quick flights by glowing geniuses but only through profound and almost geometrical reasonings. For our body is a hydraulic-pneumatic machine and contains fluids which act not only by weight and in other ways manifest to the senses but also in certain hidden ways, namely, through solution, precipitation, evaporation, congealment, filtration, and in many other processes in which composite things are dissolved into insensible parts. Unless principles are advanced from geometry and mechanics which can be applied with equal ease to sensible and insensible things alike, nature in its subtlety will escape us. And reason must supply this most important lack in experiment. For a corpuscle hundreds of thousands times smaller than any bit of dust which flies through the air, together with other corpuscles of the same subtlety, can be dealt with by reason as easily as can a ball by the hand of a player.[317]

The most perfect method involves the discovery of the interior constitution of bodies a priori from a contemplation of God, the author of things. But this method is a difficult one and not to be undertaken by anyone whatever.

Just as there is a twofold way of reasoning from experiments, one leading to the application, the other to the cause, so there is also a twofold way of discovering causes, the one a priori, the other a posteriori, and each of these may be either certain or conjectural. The a priori method is certain if we can demonstrate from the known nature of God that structure of the world which is in agreement with the divine reasons and, from this structure, can finally arrive at the principles of sensible things. This method is of all the most excellent and hence does not seem to be entirely impossible. For our mind is endowed with the concept of perfection, and we know that God works in the most perfect way. I admit, however, that, though this way is not hopeless, it is certainly difficult and that not everyone should undertake it. Besides, it is perhaps too long to be covered by men. For sensible effects are too greatly compounded to be readily reduced to their first causes. Yet superior geniuses should enter upon this way, even without the hope of arriving at particulars by means of it, in order that we may have true concepts of the universe, the greatness of God, and the nature of the soul, through which the mind can be most perfected, for this is the most important end of contemplation. Yet we believe that the absolute use of this method is conserved for a better life.[318]

Some hypotheses can satisfy so many phenomena, and so easily, that they can be taken for certain. Among other hypotheses, those are to be chosen which are the simpler; these are to be presented, in the interim, in place of the true causes.

The conjectural method a priori proceeds by hypotheses, assuming certain causes, perhaps, without proof, and showing that the things which now happen would follow from these assumptions. A hypothesis of this kind is like the key to a cryptograph, and, the simpler it is, and the greater the number of events that can be explained by it, the more probable it is. But just as it is possible to write a letter intentionally so that it can be understood by means of several different keys, of which only one is the true one, so the same effect can have several causes. Hence no firm demonstration can be made from the success of hypotheses. Yet I shall not deny that the number of phenomena which are happily explained by a given hypothesis may be so great that it must be taken as morally certain. Indeed, hypotheses of this kind are sufficient for everyday use. Yet it is also useful to apply less perfect hypotheses as substitutes for truth until a better one occurs, that is, one which explains the same phenomena more happily or more phenomena with equal felicity. There is no danger in this if we carefully distinguish the certain from the probable. To offer such hypotheses, which one knows to be fictitious, may not be useful to knowledge, yet may meanwhile serve the memory. Such are the fictitious etymologies by which Hebrew roots are derived from German words so that they can be more easily retained by German schoolboys. Phenomena are virtually contained in the hypothesis from which they can be deduced, so that anyone who remembers the hypothesis will more easily recall these phenomena when he wishes, even if he knows that the hypothesis is false and that certain other phenomena are known with which it conflicts. Thus the Ptolemaic hypothesis may suffice for the beginner in astronomy who is content with certain popular notions of heavenly bodies. In my opinion, however, it is better to teach the true conception when we have it.

Analogies are useful in guessing at causes and in making predictions.

The hypothetical method a posteriori, which proceeds from experiments, rests for the most part upon analogies. For instance, seeing that many terrestrial phenomena agree with magnetic phenomena, some men teach that the earth is a great magnet, that the structure of the earth corresponds to this, and that heavy bodies are drawn to earth as a magnet draws iron. Others explain everything by fermentation, even the ebb and flow of the tides. Still others, seeing that lye fights against acids, reduce all corporeal conflicts to those of acid and alkali. We must guard against the abuse of analogies. Yet they can be of exceedingly great use in making inductions and in setting up aphorisms from inductions by means of which we can also make predictions about matters of which we as yet have little experience. This too is useful in investigating the true causes of things, for it is always easier to discover the cause of a phenomenon which several things have in common. So it is also easier to solve cryptographs when we have found a number of letters in the concealed meaning which are written according to the same key. Then, too, the cause of the same phenomenon can be investigated more easily in one subject than in another, as anatomists who dissect different animals well know.

The method of reasoning from experiments resolves the phenomenon into its attributes and seeks the causes and effects of each attribute.

There remains the certain method of reasoning from experiments to causes, which I hold needs to be cultivated more widely and with greater care than heretofore. Many men are content with analogies because they stimulate the imagination, even though they do not satisfy the mind. But the true method of reasoning from experiments is this—we must resolve every phenomenon into all its circumstances by considering separately color, odor, taste, heat, and cold, and other tactile qualities, and, finally, the common attributes of magnitude, figure, and motion. Now if we have discovered the cause of each of these attributes in itself we will certainly have the cause of the whole phenomenon. But if by chance we do not come upon the reciprocal and permanent cause of certain attributes, but only several possible causes, we can exclude those which are not pertinent here.[319] For example, assume two attributes, *A* and *L*, of the same phenomenon and assume that there are two possible causes of *A*, namely, *b* and *c*, and two of *L*, namely, *m* and *n*. Now, if we establish that cause *b* cannot exist along with either *m* or *n*, it follows necessarily that the cause of *A* is *c*. If we can further establish that *m* cannot exist along with *c*, then the cause of *L* must be *n*. But, if it is not in our power to achieve a complete enumeration of possible causes, this method of exclusion will at most be probable. If the effects rather than the causes of a phenomenon are sought, the method is the same; the effects of the separate attributes will have to be examined.

Composite attributes are to be resolved into simple, and those which are simple with respect to the senses but not with respect to intellectual principles are to be reduced to their immediate cause.

Of the attributes which are presented to the senses, some are simple, others are compounded of simple ones. Simple attributes include heat, firmness, duration; composites are such as fusibility, which consists of a body ceasing to be firm when heated. Thus composite attributes are to be resolved into simple ones. Simple attributes, again, are simple by their own nature and for intellectual reasons, or they are simple with respect to our senses. As an example of an attribute simple in nature can be offered "to be itself" or "to endure." An attribute simple with respect to the senses, on the other hand, would be heat, for the senses do not show us by what mechanism the state of a body is produced which brings about the sensation of warmth in us, yet the mind properly perceives that warmth is not something absolute which is understood in itself but that it will only then be adequately understood when we explain of what it consists or distinctly describe its proximate cause—perhaps the expansion of air, or rather some particular motion of a fluid which is thinner than air.

Confused attributes are sufficiently distinguished only by being shown.

It follows clearly from this, moreover, that attributes which are sensible can be divided into confused and distinct by intellectual principles. Confused attributes are those which are indeed composite in themselves or by intellectual principles but are simple to the senses and whose definition therefore cannot be explained. These attributes can be imparted not by description but only by pointing them out to the senses. Imagine a land where men do not know the sun and fire and have blood which is cold, not warm; surely they cannot be made to understand what heat is merely by describing it, for, even if someone were to explain to them the innermost secrets of nature and even interpret perfectly the cause of heat, they would still not recognize heat from this description if it were presented to them, for they could not know that this peculiar sensation which they perceived in their minds is excited by this particular motion, since we cannot notice distinctly what arises in our mind and what in our organs. But, if someone kindled a fire near them, they would at length learn what heat is. Similarly a man born blind could learn the whole of optics yet not acquire any idea of light.

Distinct attributes are those whose resolution is known, if they have one.

Distinct attributes are either simple to the intellect itself or understood in themselves, as "to be," "to endure"; or they can be explained through a definition, that is, they can be recognized by us through certain signs, as, for example, roundness or the equidistance of all points from one, and gravity or a striving toward the center of the earth. The former are conceived distinctly enough without resolution, for they are incapable of resolution; the latter should be resolved into those concepts through which they may be understood and distinguished. Although certain attributes can be resolved only into others that are confused, for example, fusibility, in whose definition heat is, as we have said, an ingredient, they can nevertheless be held for distinct to the extent that they are resolved. Those attributes are more distinct, however, which are resolved into others which are distinct; for example, the figure of a circle or rectilinear motion.

Attributes common to several senses are distinct above the rest, and among the distinct attributes the homogeneous ones are the more simple.[320]

It must be noted, however, that attributes common to several senses are to be regarded as distinct in comparison with others, for they are not resolvable into confused ones, and then again into those dependent upon the senses, but into concepts attained by the intellect. Such attributes are magnitude, position, duration, and motion. We need not wonder at this, for, since they are common to several senses, they do not depend upon the particular constitution of a sense organ or upon its insensible movements, the subtlety and number of which lead to our confused perception. They depend rather upon a nature common to diverse organs, that is, the nature of the body itself, and so they are freed from the confusion of particular perceptions. It is also to be noted that among the distinct attributes those are the simpler which apply equally to the whole and to the part and which are by some called similars. Thus extension is simpler than figure, for what can be ascribed to the whole but not to the parts belongs to the whole because the whole consists of these parts. Such an attribute can therefore be explained from a consideration of the parts. So such attributes can be resolved into the attributes of the parts out of which they arise; this cannot be said of attributes that are homogeneous. But by these I mean only distinct homogeneous attributes such as extension, since confused homogeneous attributes, such as whiteness, can indeed be ascribed to the whole as well as the parts, but only to the sensible parts. For it cannot safely be said that each part of a white body, however insensible, is also white; it is rather truer to assert the contrary, since we see that, though foam is white, the single bubbles of foam are not white.

In general, the simpler and the more homogeneous attributes are to be preferred in our thinking.

In the same way, homogeneous bodies (even if only to the senses), such as fluids, salts, and metals, are to be considered as simpler than organisms like plants and animals, which are composed of various parts each of which is preferred above others in our consideration, even if all are confused. Moreover, those ways of treating and examining bodies are more useful and to be preferred in our consideration which happen "by themselves," as the chemists commonly say, that is, without the addition of anything other than the common elements of matter, fire, air, water, and earth, and these only in the highest degree of purity, without being tainted by any particular quality. And, in general, if any phenomenon arises equally in simple and composite things, or if any effect can be produced from simple or composite things alike, the simple is to be preferred. Thus experiments carried out with the aid of heat from the sun's rays are simpler than those carried out with fire from our cooking stoves, which gives forth a certain corruptive acid.

There is a way of resolving confused attributes experimentally into other attributes which is fruitful practically as well as in theory but which does not make them cease being confused.

To investigate the causes of confused attributes, however, and to obtain their resolution or an analysis of them, we must relate them to other attributes as well as to the subjects which contain them. Subjects themselves can be known only through attributes. So the bringing-together of an attribute with a subject is nothing more than the bringing-together of the attribute with an aggregate of others which concur in the same subject. Thus a confused attribute can be related either to other confused attributes or to distinct attributes. The relating of an attribute to others, however, consists in making apparent their concurrence in the same subject, their connection with each other, their compatibility, and, on the other hand, how one can be changed into another or can be produced out of several others. Thus there sometimes occurs another kind of resolution of confused attributes, which I call experimental to distinguish it from intellectual resolution. For example, the color green arises from a mixture of blue and yellow, no change taking place in the colored object but only in the eye. Furthermore, the separate ingredients can sometimes be distinguished with a microscope, each with its own color, yellow or blue. We cannot yet say with any certainty, however, that blue and yellow are prior to or simpler in nature than green, for we do not understand, but merely experience, that green arises out of yellow and blue. Therefore, neither could we have foreseen it. On the other hand, we understand though we do not experience that a square is made by two right isosceles triangles joined by a common hypotenuse and lying in the same plane or that from two odd numbers there arises an even number. For in intellectual resolution or in definition, one understands that which is described when the ingredients of the description are understood. But this is not the case in a resolution made by sense alone, and what is resolved in this way does not cease being confused. We do not grasp how the third color is given us through the confused appearance of these two colors.

When we consider the subject of any confused attribute, for example, of light, its cause or the way in which it is produced or increased, or its contrary or the way it is destroyed or diminished, and, finally, its effects, we do this by bringing it together with an aggregate of many other confused or distinct attributes taken together. But distinct attributes are to be preferred to the rest, namely, duration, magnitude, motion, figure, angle, and other circumstances, for we can reason only to the extent that we consider distinct attributes. The application of mathematics to physical science consists in such consideration of the distinct attributes which accompany confused ones. Once we have learned that the angles of incidence and reflection of a ray of light are equal and that these angles are taken with respect to the perpendicular striking a plane tangent to the surface at the point of incidence, then we can easily establish the science of catoptrics. Similarly few experiments about reflection are needed to set up the foundations of dioptrics.

Since everything confused is by its nature resolvable into the distinct, even though it may not always be in our power to do this, it follows that all qualities and mutations of bodies can, according to their nature, at length be reduced to certain distinct concepts. But in a body viewed as matter only, or as that which fills space, nothing can be conceived distinctly beyond magnitude and figure, which are themselves contained intelligibly in space, and motion, which is a variation of space. Thus material things can be explained through magnitude, figure, and motion. I know that some learned men disagree with this, and consider qualities such as heat, light, elastic force, gravity, and magnetic force, as certain absolute entities emanating from substantial forms. Nor do I completely reject their opinion, for very often it is not necessary to seek a resolution of such qualities. Thus a mechanic does not care whether a body is heavy because of an intrinsic principle or because it is impelled to the earth from without. Hence the mechanic may be permitted to take gravity, and the optician light, as something absolute to be grasped in itself. But the truth of the matter is that one must give the reason for such qualities and explain how they arise in a body. Imagine that some angel wished to explain to us how bodies are made heavy; he could achieve nothing by speaking, however beautifully, about a substantial form, or sympathy, or other things of this kind. Rather he would only then satisfy our curious understanding when he gave us an explanation, sufficiently understood, which, when we have comprehended it, will enable us to demonstrate with geometric certainty that gravity must necessarily arise from it. This angel must therefore necessarily present only such things as we can perceive distinctly. But we perceive nothing distinctly in matter save magnitude, figure, and motion. If someone wishes in addition to ascribe to bodies a substantial form or a soul, and likewise sense and appetite, I have no objection to this, but I maintain that this contributes nothing toward explaining purely material phenomena and that it is not sufficient to say that a heavy body senses and desires the earth unless we explain at the same time how this sense and this desire arise. In this way we should finally have to come to the construction of the organs of the sensing being, that is, to the mechanical principles. For what happens with perception happens nonetheless mechanically, and to the passions of the soul there correspond bodily motions in the organs which always follow mechanical laws.

I know too that there are excellent and most learned men who cannot abide having all bodily phenomena explained mechanically. For they think that this injures religion, and they believe that, if it were accepted, the world mechanism would need neither God nor any other incorporeal substance. This they rightly regard as absurd and dangerous. Hence some of them make use of an immediate intervention of God everywhere, while others introduce intelligences or angels as moving forces here and there. Some set up a kind of a world soul or a hylarchic principle, through whose operations heavy bodies are made to strive toward the earth and other things happen which are needed to conserve the world system. But all these things are insufficient to explain things, for, whether we introduce God or an angel or a soul or whatever other incorporeal operative substance, the cause and the mode of operating can always be explained in the truth which we have about the things themselves. But the way in which a body operates cannot be explained distinctly unless we explain what its parts contribute. This cannot be understood, however, unless we understand their relation to each other and to the whole in a mechanical sense, that is, their figure and position, the change of this position or motion, their magnitude, their pores, and other things of this mechanical kind, for these always vary the operation. I admit that these outstanding men have had unimpeachable grounds for shrinking back from the philosophy of certain recent thinkers, because many philosophers today resort to efficient and material causes only, completely neglecting formal and final causes. But those who are wise know that every effect has a final as well as an efficient cause—final because everything that happens is done by a perceiving being, efficient because everything that happens naturally in a body takes place through the corporeal organ and according to the laws of bodies. If those who oppose mechanical laws had known that these laws themselves are finally resolved into metaphysical reasons and that these metaphysical reasons arise from the divine will or wisdom, they would not have so strongly opposed mechanistic explanations. In fact, I have contended that no reason for physical motion can be found in mathematical rules alone but that metaphysical propositions must necessarily be added. This will be made clearer in its proper place.

Here it will be well, however, to explain a little more distinctly how a middle way can be found, in my opinion, between the Scholastic and the mechanistic basis for philosophy; or, better, in what sense there is truth on both sides. If this is understood, the internecine war will cease which has recently disturbed not only the schools and universities but from time to time also the church and the state. The mechanists condemn the Scholastics, namely, as ignorant of what is useful for living, while the Scholastics and the theologians who cultivate the Scholastic philosophy hate the mechanical philosophers as harmful to religion.[321] I must admit that both sides have exceeded proper bounds and that even the philosophers have uncautiously said things which cannot be proved. This is what I think. Everything is by nature to be understood clearly and distinctly and could be manifested to our understanding by God if he willed to do so. And the operation of a body cannot be understood adequately unless we know what its parts contribute; hence we cannot hope for the explanation of any corporeal phenomenon without taking up the arrangement of its parts. But from this it does not at all follow that nothing can be understood as true in bodies save what happens materially and mechanically, nor does it follow that only extension is to be found in matter. For even though the confused attributes of bodies can be referred back to distinct ones, we must recognize that there are two kinds of distinct attributes, one of which must be sought in mathematics, the other in metaphysics. Mathematical science provides magnitude, figure, situation, and their variations, but metaphysics provides existence, duration, action and passion, force of acting, and end of action, or the perception of the agent. Hence I believe that there is in every body a kind of sense and appetite, or a soul, and, furthermore, that to ascribe a substantial form and perception, or a soul, to man alone is as ridiculous as to believe that everything has been made for man alone and that the earth is the center of the universe. But, on the other hand, I think that, when once we have demonstrated the general mechanical laws from the wisdom of God and the nature of the soul, then it is as improper to revert to the soul or to substantial forms everywhere in explaining the particular phenomena of nature as it is to refer everything to the absolute will of God. For the action of the soul is determined by the state of the organ of the soul and its object, and the operation of God by the conditions of the individual things, and this not by the necessity of matter but by the impulsion of the final cause or the good.

33

MEDITATIONS ON KNOWLEDGE, TRUTH, AND IDEAS

Acta eruditorum, November, 1684

Leibniz's first published paper on philosophical issues (in the mature period of his thought) is the result of his criticism of Descartes's incomplete conception of truth and was clearly occasioned by the appearance of Arnauld's attack on Malebranche's theory of knowledge in the Des vraies et des fausses idées, though Leibniz did not study the controversy in detail until later.[322] That he regarded this essay as definitive for his own conception of knowledge is shown by his frequent reference to it in his later works.

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[G., IV, 422-26]

Since distinguished men are today engaged in controversies about true and false ideas, a matter of great importance for understanding the truth, and one to which even Descartes did not entirely do justice, I should like briefly to explain what I think may be established about the different kinds and the criteria of ideas and of knowledge. Knowledge is either obscure or clear; clear knowledge is either confused or distinct; distinct knowledge is either inadequate or adequate, and also either symbolic or intuitive. The most perfect knowledge is that which is both adequate and intuitive.

A concept is obscure which does not suffice for recognizing the thing represented, as when I merely remember some flower or animal which I have once seen but not well enough to recognize it when it is placed before me and to distinguish it from similar ones; or when I consider some term which the Scholastics had defined poorly, such as Aristotle's entelechy, or cause as a common term for material, formal, efficient, and final cause, or other such terms of which we have no sure definition. A proposition also becomes obscure when it contains such a concept.

Knowledge is clear, therefore, when it makes it possible for me to recognize the thing represented. Clear knowledge, in turn, is either confused or distinct. It is confused when I cannot enumerate one by one the marks which are sufficient to distinguish the thing from others, even though the thing may in truth have such marks and constituents into which its concept can be resolved. Thus we know colors, odors, flavors, and other particular objects of the senses clearly enough and discern them from each other but only by the simple evidence of the senses and not by marks that can be expressed. So we cannot explain to a blind man what red is, nor can we explain such a quality to others except by bringing them into the presence of the thing and making them see, smell, or taste it, or at least by reminding them of some similar perception they have had in the past. Yet it is certain that the concepts of these qualities are composite and can be resolved, for they certainly have their causes. Likewise we sometimes see painters and other artists correctly judge what has been done well or done badly; yet they are often unable to give a reason for their judgment but tell the inquirer that the work which displeases them lacks "something, I know not what."

A distinct concept, however, is the kind of notion which assayers have of gold; one, namely, which enables them to distinguish gold from all other bodies by sufficient marks and observations. We usually have such concepts about objects common to many senses,[323] such as number, magnitude, and figure, and also about many affections of the mind such as hope and fear; in a word, about all concepts of which we have a nominal definition, which is nothing but the enumeration of sufficient marks. We may also have distinct knowledge of an indefinable concept, however, when this concept is primitive or is the mark of itself, that is, when it is irreducible and to be understood only through itself and therefore lacks requisite marks. But in composite concepts the single component marks are indeed sometimes known clearly but nevertheless confusedly, such as heaviness, color, aqua fortis, and others which are some of the marks of gold. Such knowledge of gold may therefore be distinct, but it is nonetheless inadequate. But when every ingredient that enters into a distinct concept is itself known distinctly, or when analysis is carried through to the end, knowledge is adequate. I am not sure that a perfect example of this can be given by man, but our concept of numbers approaches it closely. Yet for the most part, especially in a longer analysis, we do not intuit the entire nature of the subject matter at once but make use of signs instead of things, though we usually omit the explanation of these signs in any actually present thought for the sake of brevity, knowing or believing that we have the power to do it. Thus when I think of a chiliogon, or a polygon of a thousand equal sides, I do not always consider the nature of a side and of equality and of a thousand (or the cube of ten), but I use these words, whose meaning appears obscurely and imperfectly to the mind, in place of the ideas which I have of them, because I remember that I know the meaning of the words but that their interpretation is not necessary for the present judgment. Such knowledge I usually call blind or symbolic; we use it in algebra and in arithmetic, and indeed almost everywhere. When a concept is very complex, we certainly cannot think simultaneously of all the concepts which compose it. But when this is possible, or at least insofar as it is possible, I call the knowledge intuitive. There is no other knowledge than intuitive of a distinct primitive concept, while for the most part we have only symbolic knowledge of composites.

This already shows that we do not perceive the ideas even of those things which we know distinctly, except insofar as we use intuitive knowledge. It often happens that we falsely believe ourselves to have ideas of things in our mind, when we assume wrongly that we have already explained certain terms which we are using. It is not true, or at least it is ambiguous, to say, as some do, that we cannot speak of anything and understand what we say, without having an idea of it. For often we understand perfectly each single word or remember to have understood it earlier; yet, because we are content with this blind knowledge and do not sufficiently press the analysis of the concepts, we overlook a contradiction which the composite concept may involve. I was led to examine this point more distinctly by an argument which was famous among the Scholastics long ago and was revived by Descartes. It is an argument for the existence of God and is stated as follows. Whatever follows from the idea or definition of a thing can be predicated of the thing itself. Existence follows from the idea of God, or the most perfect being, or that than which no greater can be thought. For a most perfect being involves all perfections, among which existence is one. Therefore existence can be predicated of God.

It should be noticed, however, that the most you can draw out of this argument is that, if God is possible, it follows that he exists; for we cannot safely infer from definitions until we know that they are real or that they involve no contradiction. The reason for this is that, from concepts which involve a contradiction, contradictory conclusions can be drawn simultaneously, and this is absurd. To explain this I usually make use of the example of the most rapid motion, which involves an absurdity. Suppose that a wheel turns at a most rapid rate. Then anyone can see that, if a spoke of the wheel is extended beyond its rim, its extremity will move more rapidly than will a nail in the rim itself. The motion of the nail is therefore not the most rapid, contrary to hypothesis. Yet, at first glance we may seem to have an idea of the most rapid motion, for we understand perfectly what we are saying. But we cannot have any idea of the impossible. Likewise it is not enough to think of a most perfect being in order to assert that we have an idea of it, and in the demonstration which I referred to above we must either prove or assume the possibility of a most perfect being in order to reason rightly. However, there is nothing truer than that we have an idea of God and that the most perfect being is possible and, indeed, necessary. But the above argument is not conclusive and has already been rejected by Thomas Aquinas.

This gives us, too, a means of distinguishing between nominal definitions, which contain only marks for discerning one thing from others, and real definitions, through which the possibility of the thing is ascertained. In this way we can meet the view of Hobbes, who held truths to be arbitrary because they depend on nominal definitions, not considering that the reality of the definition does not depend upon our free choice and that not all concepts can be combined with each other.[324] Nominal definitions do not suffice for perfect knowledge unless it has been established by other means that the defined thing is possible.

Thus the difference between a true and a false idea also becomes clear. An idea is true when the concept is possible; it is false when it implies a contradiction. Now, we know the possibility of a thing either a priori or a posteriori. We know it a priori when we resolve the concept into its necessary elements or into other concepts whose possibility is known, and we know that there is nothing incompatible in them. This happens, for instance, when we understand the method by which the thing can be produced; hence causal definitions are more useful than others. We know an idea a posteriori when we actually experience the thing to exist, for what actually exists or has existed is in any case possible. Whenever our knowledge is adequate, we have a priori knowledge of a possibility, for if we have carried out the analysis to the end and no contradiction has appeared, the concept is obviously possible. Whether men will ever be able to carry out a perfect analysis of concepts, that is, to reduce their thoughts to the first possibles or to irreducible concepts, or (what is the same thing) to the absolute attributes of God themselves or the first causes and the final ends of things, I shall not now venture to decide.[325] For the most part we are content to learn the reality of certain concepts by experience and then to compose other concepts from them after the pattern of nature.

From this therefore I believe we can understand that it is not always safe to appeal to ideas and that many thinkers have abused this deceptive word to establish some of their own fancies. That we do not always at once have an idea of a thing of which we are conscious of thinking, the example of most rapid motion has shown. Nor is it less deceptive, I think, when men today advance the famous principle that *whatever I perceive clearly and distinctly in some thing is true, or may be predicated of it*. For what seems clear and distinct to men when they judge rashly is frequently obscure and confused. This axiom is thus useless unless the criteria of clearness and distinctness which we have proposed are applied and unless the truth of the ideas is established. For the rest, the *rules of common logic*, of which also the geometricians make use, are not to be despised as criteria of the truth of judgments; so, for example, the rule that nothing is to be admitted for certain unless it has been proved by careful experience or by sound demonstration. A demonstration is sound when it observes the form prescribed in logic, although it need not always follow the form of syllogisms arranged in the Scholastic manner (such as Christian Herlinus and Conrad Dasypodius applied to the first six books of Euclid);[326] it is merely necessary that the argument be conclusive by virtue of its form. As an example of such argumentation carried through in proper form one could also quote any valid calculation. Thus no necessary premise is to be omitted, and all premises must be proved in advance, or at least admitted to be hypotheses, in which case the conclusion, too, is hypothetical. Whoever obeys these rules carefully will easily protect himself against deceptive ideas. That brilliant genius Pascal agrees entirely with these principles when he says, in his famous dissertation on the geometrical spirit, a fragment of which is preserved in the outstanding book of the celebrated Antoine Arnauld on the *Art of Thinking*,[327] that it is the task of the geometrician to define all terms though ever so little obscure and to prove all truths though little doubtful. I only wish that he had defined the limits beyond which any concept or judgment is no longer even a little obscure or doubtful. But the necessary conditions for this can be learned from a careful study of what we have just said; we must now strive to be brief.

As to the controversy whether we see all things in God (an old opinion which, properly understood, is not entirely to be rejected) or whether we have some ideas of our own,[328] it must be understood that, even if we saw all things in God, it would still be necessary to have our own ideas also, not in the sense of some kind of little copies, but as affections or modifications of our mind, corresponding to the very object we perceive in God. For, whenever thoughts succeed each other, some change occurs in our mind. There are also ideas in our mind of things of which we are not actually thinking, as the figure of Hercules is in the rough marble. But in God there must actually be the ideas not only of absolute and infinite extension but also of every figure, since figure is nothing but a modification of absolute extension.[329] Moreover, when we perceive colors or odors, we are having nothing but a perception of figures and motions, but of figures and motions so complex and minute that our mind in its present state is incapable of observing each distinctly and therefore fails to notice that its perception is compounded of single perceptions of exceedingly small figures and motions. So when we mix yellow and blue powders and perceive a green color, we are in fact sensing nothing but yellow and blue thoroughly mixed; but we do not notice this and so assume some new nature instead.

34

A BRIEF DEMONSTRATION OF A NOTABLE ERROR OF DESCARTES AND OTHERS CONCERNING A NATURAL LAW,

According to Which God Is Said Always To Conserve the Same Quantity of Motion; a Law Which They Also Misuse in Mechanics

Acta eruditorum, March, 1686

In this criticism of the Cartesian principle of the constancy of quantity of motion, or of momentum, Leibniz began to fulfil his promise to refute the Cartesian physics, and particularly the laws of motion, by means of a new principle (No. 31, III). His analysis of the relations of energy expended and work done involves the principle of equipollence as applied to physical processes. Replies were made to the paper by two outstanding Cartesians, the Abbé Catelan in 1686 and Denis Papin in 1691. Both answers involved Leibniz in a series of discussions which led to sharper formulations of his principles. The supplement is a later addition which reflects his thinking at the time of the *Specimen dynamicum* (No. 46).

* * *

[GM., VI, 117-19]

Seeing that velocity and mass compensate for each other in the five common machines, a number of mathematicians have estimated the force of motion by the quantity of motion or by the product of the body and its velocity. Or, to speak rather in geometrical terms, the forces of two bodies (of the same kind) set in motion, and acting by their mass as well as by their motion, are said to be proportional jointly to their bodies or masses and to their velocities. Now since it is reasonable that the same sum of motive force should be conserved in nature and not be diminished—since we never see force lost by one body without being transferred to another—or augmented, a perpetual motion machine can never be successful because no machine, not even the world as a whole, can increase its force without a new impulse from without. This led Descartes, who held motive force and quantity of motion to be equivalent, to assert that God conserves the same quantity of motion in the world.[330]

In order to show what a great difference there is between these two concepts, I begin by assuming, on the other hand, that a body falling from a certain altitude acquires the same force which is necessary to lift it back to its original altitude if its direction were to carry it back and if nothing external interfered with it. For example, a pendulum would return to exactly the height from which it falls except for the air resistance and other similar obstacles which absorb something of its force and which we shall now refrain from considering. I assume also, in the second place, that the same force is necessary to raise the body A (Fig. 11) of 1 pound to the height CD of 4 yards as is necessary to raise the body B of 4 pounds to the height EF of 1 yard. Cartesians as well as other philosophers and mathematicians of our times admit both of these assumptions. Hence it follows that the body A, in falling from the height CD, should acquire precisely the same amount of force as the body B falling from the height EF. For, in falling from C and reaching D, the body A will have there the force required to rise again to C, by the first assumption; that is, it will

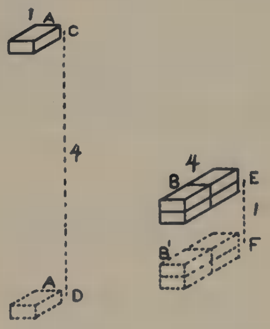

Fig. 11

have the force needed to raise a body of 1 pound (namely, itself) to the height of 4 yards. Similarly the body *B*, after falling from *E* to *F*, will there have the force required to rise again to *E*, by the first assumption; that is, it will have the force sufficient to raise a body of 4 pounds (itself, namely) to a height of 1 yard. Therefore, by the second assumption, the force of the body *A* when it arrives at *D* and that of the body *B* at *F* are equal.

Now let us see whether the quantities of motion are the same in both cases. Contrary to expectations, there appears a very great difference here. I shall explain it in this way. Galileo has proved that the velocity acquired in the fall *CD* is twice the velocity acquired in the fall *EF*. So, if we multiply the mass of *A* (which is 1) by its velocity (which is 2), the product, or the quantity of motion, is 2; on the other hand, if we multiply the body *B* (which is 4) by its velocity (which is 1), the product, or quantity of motion, is 4. Therefore the quantity of motion of the body *A* at *D* is half the quantity of motion of the body *B* at *F*, yet their forces are equal, as we have just seen.[331] There is thus a big difference between motive force and quantity of motion, and the one cannot be calculated by the other, as we undertook to show. It seems from this that *force* is rather to be estimated from the quantity of the *effect* which it can produce; for example, from the height to which it can elevate a heavy body of a given magnitude and kind but not from the velocity which it can impress upon the body. For not merely a double force, but one greater than this, is necessary to double the given velocity of the same body. We need not wonder that in common machines, the lever, windlass, pulley, wedge, screw, and the like, there exists an equilibrium, since the mass of one body is compensated for by the velocity of the other; the nature of the machine here makes the magnitudes of the bodies—assuming that they are of the same kind—reciprocally proportional to their velocities, so that the same quantity of motion is produced on either side. For in this special case the *quantity of the effect*, or the height risen or fallen, will be the same on both sides, no matter to which side of the balance the motion is applied. It is therefore merely accidental here that the force can be estimated from the quantity of motion. There are other cases, such as the one given earlier, in which they do not coincide.[332]

Since nothing is simpler than our proof, it is surprising that it did not occur to Descartes or to the Cartesians, who are most learned men. But the former was led astray by too great a faith in his own genius; the latter, in the genius of others. For, by a vice common to great men, Descartes finally became a little too confident, and I fear that the Cartesians are gradually beginning to imitate many of the Peripatetics at whom they have laughed; they are forming the habit, that is, of consulting the books of their master instead of right reason and the nature of things.

It must be said, therefore, that forces are proportional, jointly, to bodies (of the same specific gravity or solidity) and to the heights which produce their velocity or from which their velocities can be acquired. More generally, since no velocities may actually be produced, the forces are proportional to the heights which might be produced by these velocities. They are not generally proportional to their own velocities, though this may seem plausible at first view and has in fact usually been held. Many errors have arisen from this latter view, such as can be found in the mathematico-mechanical works of Honoratius Fabri, Claude Dechales, John Alfonso Borelli, and other men who have otherwise distinguished themselves in these fields. In fact, I believe this error is also the reason why a number of scholars have recently questioned Huygens' law for the center of oscillation of a pendulum, which is completely true.[333]

Supplement

It is to be shown that the power required to lift 1 pound 2 feet is the same as the power required to lift 2 pounds 1 foot.

This proposition is not only admitted but explicitly applied and regarded as a principle by Descartes in his letters and the short treatise on mechanics which was edited with his letters, and separately as well. It was also accepted by Pascal in his treatise on the equilibrium of fluids; by Samuel Morland, the Englishman who invented the stentorian tubes, in the hydraulic treatise which he recently published;[334] and by a certain learned Cartesian who has tried to reply to my demonstration against Descartes in the *Nouvelles de la république des lettres* published in Holland with a number of evasions, though he did not adequately understand my argument.[335] I shall not mention other Cartesians or the opinions of other philosophers. So I can safely apply the principle in refuting the alleged natural law of the Cartesians.

The same proposition is confirmed also by the five commonly recognized mechanical powers—the lever, windlass, pulley, wedge, and screw; for in all these our proposition seems to be true. For the sake of brevity, however, it will suffice to show this in the single case of the lever, or—what amounts to the same thing—to deduce from our rule that the distances and weights of bodies in equilibrium are in reciprocal proportion. Let us assume *AC* (Fig. 12) to be double *BC*, and the weight *B* double the weight *A*; then I say *A* and *B* are in equilibrium. For if we assume either one to preponderate, *B*, for example, and so to sink to *B*', and *A* to rise to *A*', and drop perpendiculars *A'E* and *B'D* from *A*' and *B*' to *AB*, it is clear that, if *DB*' is 1 foot, *A'E* will be 2 feet, and therefore that, if 2 pounds descend the distance of 1 foot, 1 pound will ascend to the height of 2 feet, and thus that, since these two are equivalent, nothing is gained and the descent becomes useless, everything remaining in equilibrium as before.[336] It can be shown in the same way that *A* cannot descend or predominate. So our proposition or hypothesis, so to speak, is confirmed a posteriori, for, by assuming it, one can prove that all the common mechanical propositions apply to equilibrium or to the five machines.

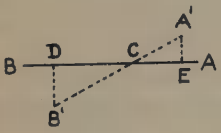

Fig. 12

Indeed, I might even risk affirming that there is no mechanical theorem by which our hypothesis is not confirmed or presupposed, as can be shown, for instance, by the law of the inclined plane, or by fountains, or by the acceleration of falling bodies. Even if some of these seem reconcilable with that hypothesis which estimates power by the product of mass by velocity, this is only accidentally, since the two hypotheses coincide in the case of dead forces [*potentia mortuus*] in which only the beginning or end of conatuses is actualized. But in living forces, or those acting with an actually completed impetus, there arises a difference, just as the example shows which I have given above in the published paper. For living power is to dead power, or impetus (actual velocity) is to conatus, as a line is to a point or as a plane is to a line. Just as two circles are not proportional to their diameters, so the living forces of equal bodies are not proportional to their velocities but to the squares of their velocities.

But since we cannot stop with an appeal to authority in this matter, and the mind which seeks to know will not be satisfied with mere inductions and hypotheses, we will now give a demonstration of our proposition, so that it can be placed for the future among the immutable foundations of the science of mechanics.

I *assume* the single principle that *a heavy body, falling from any height, will have exactly or precisely the power necessary for it to rise back to the same height*, if it is understood to have lost no force on its way by friction or resistance by the medium or some other body.

Corollary. *So a body of 1 pound which descends from a height of 1 foot, acquires exactly the power of raising a body of 1 pound* (equal to the first body itself) *to the height of 1 foot*.

I *postulate* besides that *I am permitted to assume various connections of the heavy bodies with each other, and their separation again, and to introduce any other changes which do not involve a change of force*. I also make use of threads, axes, levers, and other mechanisms lacking in weight and resistance.[337]

Theorem. *With these assumptions, I assert that the fall of* the body B (Fig. 13) of 1 pound for the distance BB'', a height of 2 feet, will have exactly as much force as is necessary to raise the body A of 2 pounds to the height of AA' of 1 foot.

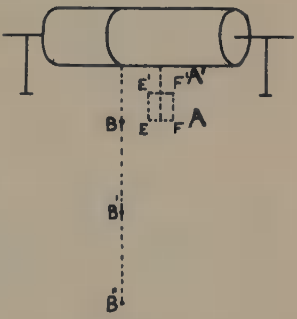

Fig. 13

Demonstration. I assume the body A composed of two parts, E and F, each of which is 1 pound. Now the body B, of 1 pound, has exactly the power, in descending from the height BB' of 1 foot, that is necessary to raise the body E of 1 pound to the height EE' of 1 foot (by the corollary), if a connection is assumed between them (by the postulate). We assume further (by the same postulate) that the body B in the position B' is freed from its connection with body E, which remains at E', and is connected now with body F. Then the body B, continuing its descent for the distance B'B'' will be able to lift the body F of 1 pound for the distance FF', a height of 1 foot (by the corollary). Therefore the whole body B of 1 pound, descending 2 feet, BB'', has raised the body composed of both E and F, or A, of 2 pounds through AA', a height of 1 foot. But exactly this was to be proved possible.

Scholium

If the matter is carefully considered, it will easily be understood, without any apparatus or figures, that these two things are equivalent—to raise 1 pound to 2 feet (i.e., a pound 1 foot, and then again a pound 1 foot), and to raise 2 pounds 1 foot (i.e., a pound 1 foot and, joined to it, another pound 1 foot). In general, forces are to be calculated from their effects, not from the time; for time can be varied by external circumstances. Thus the sphere C, with a specific impetus (degree of velocity) by whose action it can raise itself to the height HG on an inclined plane LM or LN, needs more

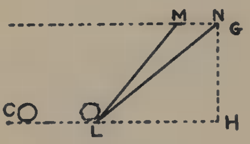

Fig. 14

time in proportion to the increasing length of the plane (Fig. 14). In either case, however, it will rise to the same perpendicular height if, naturally (as must be done in these problems), the resistance of air and the plane be taken as zero. The force of the sphere will remain the same, whatever may be the inclination of the line in which it lifts itself. I understand here such an effect as itself constitutes a natural force or one by whose production the impetus is diminished. Such an effect is the ascent or elevation of any heavy object, the tension of a spring, the impulsion of a body to motion or the retardation of its motion, and other operations of this kind. On the other hand, the greater or less progress of a body once put in motion in a horizontal plane is not an effect of this kind from which I calculate absolute force, for the force remains the same during the progress of the body in this case. This is worth noting explicitly for the sake of avoiding errors, since it has not been adequately explained. Of course I admit that, from a given time or its reciprocal, the velocity, and from other known circumstances, a judgment is possible about the force of a given body; but I assert that not the time nor the velocity but only the effect is an absolute measure of force, for, when the force remains the same, the effect remains the same, and neither the time nor other circumstances can vary it. Hence it is not surprising that the forces of two equal bodies are proportional not to their velocities but to the causes or the effects of their velocity, i.e., to the heights producing them or capable of being produced by them, or to the squares of their velocities. It also follows, therefore, that, when two bodies collide, there is conserved after the collision, not the same quantity of motion or impetus, but the same quantity of force.[338] It follows also that a string must be stretched by a fourfold weight to produce a tone twice as high, for the weight represents the force, the sound the velocity of the vibrations of the string. The ultimate reason, however, is that motion is not something absolute and real in itself.

35

"Discourse on Metaphysics"

1686

The first mature synthesis of Leibniz's philosophical opinions is an essay without title which is described in a letter to the Landgrave Ernest of Hesse-Rheinfels on February 1/11, 1686.

> Finding myself recently at a place with nothing to do for a few days, I wrote a little discourse on metaphysics, on which I should like to have the opinion of Mr. Arnauld. For I have treated the questions of grace, the co-operation of God with creatures, the nature of miracles, the cause of sin, the origin of evil, the immortality of the soul, ideas, etc., in a way which seems to provide new openings proper to clearing up the greatest difficulties [G., II, 11].

So far as is known, however, the work itself was never sent to Arnauld, but only the thirty-seven propositions summarizing its conclusions, which Leibniz asked the Landgrave to forward to him. Though it has been esteemed very highly as a statement of Leibniz's mature philosophy, he himself considered it inadequate on the nature and kinds of substances, on the interpretation of body, and on the various degrees of perception. In contrast to his later philosophical summaries (Nos. 66 and 67), its emphasis is predominantly theological, beginning with the argument for God rather than with the argument for individual substances, and it may have been a study for the preface to the Catholic Demonstrations.

Gerhardt's text has been corrected with the comparatively collated text of Schmalenbach (Sch. I, 1-50) based on the critical edition by Lestienne. Only the more significant variations found in earlier drafts of the essay, of which G.'s text is the third, are found in the notes.

* * *

[G., IV, 427-63]

1. The most widely accepted and meaningful concept which we have of God is very well expressed in the phrase that he is an absolutely perfect being; yet the consequences of this definition have not been adequately considered. To penetrate more deeply into its meaning, it is convenient to notice that there are several entirely different perfections in nature, that God possesses them all together, and that each one belongs to him in a supreme degree. We must also know what is meant by perfection. A fairly sure test of it is this one: those forms or natures which are incapable of a highest degree are not perfections; for example, the nature of number or figure. For the greatest number of all, or the number of all numbers, and the greatest of all figures are concepts which imply contradiction, but the greatest knowledge and omnipotence involve no impossibility. Therefore power and knowledge are perfections and, insofar as they belong to God, have no limits. Hence it follows that God, who possesses supreme and infinite wisdom, acts in the most perfect way and does this not only in a metaphysical but also in a moral sense. With respect to ourselves we can also express this as follows: the more enlightened and informed we are about the works of God, the more we shall be inclined to find them excellent and in entire conformity with everything which might have been desired.

2. Thus I am far from holding to the opinion of those who maintain that there are no rules of goodness and perfection in the nature of things or in the ideas which God has of them and who say that the works of God are good only for the formal reason that God has made them. For, if this were so, God, who knows that he is the author of things, would have had no reason to regard them afterward and find them good, as is reported in the Holy Scriptures, which seem to have used this anthropological conception only to make us understand that the excellence of God's works may be recognized by considering them in themselves, even without reflecting

upon this empty designation which relates them to their cause. This is all the more true, since it is through a consideration of his works that we can discover the craftsman. Thus his works must carry his mark in themselves. I confess that the contrary opinion seems to me extremely dangerous and to come very near to that of the latest innovators[339] whose opinion it is that the beauty of the universe and the goodness which we ascribe to the works of God are nothing but the chimeras of men who think of him in terms of themselves. Then, too, when we say that things are not good by any rule of excellence but solely by the will of God, we unknowingly destroy, I think, all the love of God and all his glory. For why praise him for what he has done if he would be equally praiseworthy in doing exactly the opposite? Where will his justice and wisdom be found if nothing is left but a certain despotic power, if will takes the place of reason, and if, according to the definition of tyrants, that which is pleasing to the most powerful is by that very fact just? Besides it seems that every act of will implies some reason for willing and that this reason naturally precedes the act of will itself. This is why I find entirely strange, also, the expression of certain other philosophers who say that the eternal truths of metaphysics and geometry, and consequently also the rules of goodness, justice, and perfection, are merely the effects of the will of God; while it seems to me that they are rather the consequences of his understanding, which certainly does not depend upon his will any more than does his essence.

3. Nor am I able to approve the opinion of certain moderns who maintain boldly that what God has done is not supremely perfect but that he could have done much better. For it seems to me that the consequences of this opinion are wholly contrary to the glory of God. Uti minus malum habet rationem boni, ita minus bonum habet rationem mali.[340] To act with less perfection than one is capable of is to act imperfectly. To show that an architect could have done his work better is to find fault with his work. This opinion is also contrary to the Holy Scriptures, which assure us

of the goodness of God's works. For, supposing this opinion were justified, since the imperfections follow a scale descending endlessly, whatever works God might have created, they would always be good in comparison with the less perfect. But a thing is hardly praiseworthy if it can be praised only in this way. I believe also that a great many passages will be found in the divine writings and the Church Fathers which favor my opinion but scarcely any supporting that of the moderns,[341] an opinion which was, I think, unknown to all antiquity and is based only on the inadequate knowledge which we have of the general harmony of the universe and the hidden reasons for God's conduct. This makes us judge rashly that many things might have been made better. Besides, these moderns insist on certain untenable subtleties, for they imagine that nothing is so perfect that there is not something more perfect, which is an error.[342] They believe also that thus they are safeguarding God's freedom, as though it were not the highest freedom to act in perfection according to sovereign reason. For to think that God acts in any matter without having any reason for his will, even overlooking the fact that this seems impossible, is an opinion which is hardly in accord with God's glory. Let us assume, for example, that God chooses between A and B and that he takes A without having any reason for preferring it to B. I say that such action by God is at least not praiseworthy, for all praise should be based on some reason, and there is none here, by hypothesis. I hold, instead, that God does nothing for which he does not deserve to be praised.

4. The general knowledge of this great truth, that God always acts in the most perfect and the most desirable way possible, is in my opinion the basis of the love which we owe to God above all things, since he who loves seeks his satisfaction in the felicity or perfection of the object loved and of his actions. Idem velle et idem nolle vera amicitia est.[343] I believe that it is difficult to love God truly when one is not inclined to will what he wills when one has the power to change it. In fact, those who are not satisfied with what he does seem to me like discontented subjects whose inten-

tions are not very different from those of rebels. According to these principles, I hold therefore that, in order to act in conformity to the love of God, it is not enough to force ourselves to be patient; we must be truly satisfied with everything that has happened to us according to his will. I mean this acquiescence to apply to the past; for as to the future we ought not to be quietists and stand with folded arms ridiculously waiting to see what God will do, in conformity with the sophism which the ancients called λόγον ἄεργον, or the lazy reason.[344] We must rather act in accordance with the presumptive will of God, so far as we are able to know it, trying with all our might to contribute to the general welfare and particularly to the ornament and perfection of that which concerns us or that which is nearest us and, so to speak, within our reach. For, though the outcome may perhaps show us that God did not wish our good will to be effective for the present, it does not follow that he did not will us to do what we did. On the contrary, since he is the best of all masters, he never demands more than righteous intentions, and it is for him to know the proper hour and place for making our good designs successful.

5. It is enough, then, to have this confidence in God that he does everything for the best and that nothing can harm those who love him. But to understand the reasons in particular which have moved him to choose this order of the universe—to allow sin to be committed, to dispense his saving grace in a certain way—this surpasses the powers of a finite mind, especially if this mind has not yet attained the blessedness of the vision of God. Some general remarks can be made, however, about the ways of providence in the government of affairs. It can be said, then, that he who acts perfectly is like an excellent geometrician who knows how to find the best constructions of a problem; or a good architect who makes the most advantageous use of the space and the capital intended for a building, leaving nothing which offends or which lacks the beauty of which it is capable; or a good family head who makes such use of his holdings that there is nothing uncultivated and barren; or a

skilled machinist who produces his work by the easiest process that can be chosen; or a learned author who includes the greatest number of subjects in the smallest possible volume. But the most perfect of all beings, and those which occupy the smallest volume, that is to say, those which least obstruct each other, are spirits, whose perfections consist in their virtues. This is why there can be no doubt that the happiness[345] of spirits is the principal end of God and that he puts this principle into practice as far as the general harmony permits. We shall have more to say about this later. As for the simplicity of the ways of God, this is shown especially in the means which he uses, whereas the variety, opulence, and abundance appears in regard to the ends or results. The one ought thus to be in equilibrium with the other, just as the funds intended for a building should be proportional to the size and beauty one requires in it. It is true that nothing costs God anything, even less than it costs a philosopher to build the fabric of his imaginary world out of hypotheses, since God has only to make his decrees in order to create a real world. But, where wisdom is concerned, decrees or hypotheses are comparable to expenditures, in the degree to which they are independent of each other, for reason demands that we avoid multiplying hypotheses or principles, somewhat as the simplest system is always preferred in astronomy.[346]

6. The volitions or actions of God are commonly classified into ordinary and extraordinary acts. But it is well to understand that God does nothing without order. So whatever passes for extraordinary is so only in relation to some particular order established among creatures. For, as concerns universal order, everything is in conformity with it. So true is this that not only does nothing happen in the world which is absolutely irregular but one cannot even imagine such an event. For let us assume that someone puts down a number of points on paper entirely at random, as do those who practice the ludicrous art of geomancy; I maintain that it is possible to find a geometric line whose law is constant and uniform and follows a certain rule which will pass through all these points

and in the same order in which they were drawn. And if someone draws an uninterrupted curve which is now straight, now circular, and now of some other nature, it is possible to find a concept, a rule, or an equation common to all the points of the line, in accordance with which these very changes must take place. There is no face, for example, whose contour does not form part of a geometric curve and cannot be drawn at a stroke by a certain regular movement. But, when the rule for this movement is very complex, the line which conforms to it passes for irregular. Thus we may say that, no matter how God might have created the world, it would always have been regular and in a certain general order. But God has chosen that world which is the most perfect, that is to say, which is at the same time the simplest in its hypotheses and the richest in phenomena, as might be a geometric line whose construction would be easy but whose properties and effects would be very remarkable and of a wide reach. I make use of these comparisons merely to portray an imperfect semblance of the divine wisdom and to say that which can at least lift our spirit to some conception of what cannot well be expressed. But I do not at all claim to explain by means of it the great mystery upon which the entire universe depends.

7. Now, since nothing can happen which is not according to order, it can be said that miracles are as much subject to order as are natural operations and that the latter are called natural because they conform to certain subordinate maxims which we call the nature of things. For we may say that this nature is merely a custom of God's with which he can dispense for any reason stronger than that which moved him to use these maxims. As for general or particular volitions, we may say, depending upon how the matter is understood, that God does everything according to his most general will which conforms with the most perfect order which he has chosen. But we can also say that he has particular volitions which are exceptions to these subordinate maxims.[347] For the most general of God's laws, which rules the whole sequence of the

universe, is without exceptions. It can also be said that God wills everything which is an object of his particular volition; but as for the objectives of his general will, such as the actions of creatures, especially of those which are reasonable and with whom God wishes to co-operate, we must make a distinction. If the action is good in itself, we can say that God wishes it and sometimes commands it, even though it does not take place. But if the action is evil in itself, and becomes good only by accident because the course of events, particularly punishment and satisfaction, corrects its malignity and repays the evil with interest in such a way that more perfection is found in the whole sequence than if the evil had not occurred—then we must say that God permits it but not that he wills it, although he has concurred in it through the natural laws which he has established and because he knows how to draw a greater good from it.

8. It is rather difficult to distinguish the actions of God from those of creatures,[348] for there are those who believe that God does everything, while others imagine that he does nothing but conserve the force which he has given to creatures. We shall see in what follows the sense in which we can say the one or the other. Now, since activity and passivity pertain distinctively to individual substances (actiones sunt suppositorum),[349] it will be necessary to explain what such a substance is. It is of course true that when a number of predicates are attributed to a single subject, while this subject is not attributed to any other, it is called an individual substance. But this is not enough, and such a definition is merely nominal. We must consider, then, what it means to be truly attributed to a certain subject. Now it is certain that every true predication has some basis in the nature of things, and when a proposition is not an identity, that is to say, when the predicate is not expressly contained in the subject, it must be included in it virtually. This is what the philosophers call in-esse, when they say that the predicate is in the subject. So the subject term must always include the predicate term in such a way that anyone who understands

perfectly the concept of the subject will also know that the predicate pertains to it. This being premised, we can say it is the nature of an individual substance or complete being to have a concept so complete that it is sufficient to make us understand and deduce from it all the predicates of the subject to which the concept is attributed. An accident, on the other hand, is a being whose concept does not include everything that can be attributed to the subject to which the concept is attributed. Thus the quality of king which belonged to Alexander the Great, if we abstract it from its subject, is not determined enough to define an individual, for it does not include the other qualities of the same subject or everything which the concept of this prince includes. God, on the contrary, in seeing the individual notion or "haecceity" of Alexander, sees in it at the same time the basis and the reason for all the predicates which can truly be affirmed of him—for example, that he will conquer Darius and Porus—even knowing a priori (and not by experience) what we can know only through history—whether he died a natural death or by poison. Thus, when we well consider the connection of things, it can be said that there are at all times in the soul of Alexander traces of all that has happened to him and marks of all that will happen to him and even traces of all that happens in the universe, though it belongs only to God to know them all.

9. From these considerations there follow a number of important paradoxes; among others that it is not true that two substances can resemble each other completely and differ only in number and that what St. Thomas says on this point about angels or intelligences (quod ibi omne individuum sit species infima)[350] is true of all substances, provided that we take the specific difference as geometricians understand it in their figures. It follows also that a substance cannot come into being except by creation, or perish except by annihilation; that a substance cannot be divided in two, or one substance made out of two, so that the number of substances does not increase or diminish naturally, though they

are often transformed. Moreover, every substance is like an entire world, and like a mirror of God, or of the whole universe which it expresses, each in its own manner, about as the same city is represented differently depending on the different positions from which it is regarded. Thus the universe is, in a certain sense, multiplied as many times as there are substances, and the glory of God is likewise redoubled by as many wholly different representations of his work. It can even be said that every substance in some way bears the character of God's infinite wisdom and omnipotence and imitates him as much as it is capable. For it expresses, however confusedly, everything that takes place in the universe, past, present, or future; this resembles somewhat an infinite perception or an infinite knowledge. And since all other substances in their turn express this one in their own way, and adapt themselves to it, it can be said that each extends its power over all the rest in imitation of the omnipotence of the creator.

10. Not only the ancients but also many able men given to deep meditation who taught theology and philosophy some centuries ago, some of whom are to be respected also for their saintliness, seem to have had some knowledge of what we have just said; this is why they have introduced and maintained the substantial forms which are so widely discredited today. But they are not so far from the truth, or so ridiculous, as our modern philosophers commonly imagine. I agree that the consideration of these forms serves no purpose in the details of physics and that they ought not to be used to explain particular phenomena. In this the Scholastics failed, as did the physicists of the past who imitated them, thinking that they could account for the properties of bodies by mentioning forms and qualities, without taking pains to examine the manner of their operation. This is as if one were content to say that a clock has a time-indicating property proceeding[351] from its form, without inquiring wherein this property consists. This is, of course, enough for the man who buys it, if he turns over its care to someone else. But this inadequate understanding and abuse of the forms ought not to make

us reject something whose knowledge is so necessary in metaphysics that without it, I hold, we cannot well understand the first principles or raise the spirit to the knowledge of incorporeal natures and the wonders of God. A geometrician does not need to encumber his mind with the famous labyrinth of the composition of the continuum, and no moral philosopher, and still less a jurisconsult or politician, needs to trouble himself with the great difficulties involved in reconciling free will with the providence of God, since the geometrician can carry through his demonstrations, and the politician finish his deliberations, without entering these discussions; yet these problems are nonetheless necessary and important in philosophy and theology. Just so a physicist can give an explanation of his experiments, making use, now of simpler experiences already past, now of geometric and mechanical demonstrations, without needing the general considerations which belong to another sphere. If he does make use of the co-operation of God or of some soul or Archeus,[352] or of something else of this nature, he is raving, just as much as a man who would enter into the great discussion concerning the nature of destiny and of our liberty, in deciding an important practical problem. Men in fact often commit this fault without thinking of it when they encumber their mind by the consideration of fatalism and are even sometimes diverted by it from some good resolve or from some necessary concern.

11. I know that I am advancing a great paradox in seeking to restore the old philosophy in some respects and to restore these almost-banished substantial forms. But perhaps I shall not be condemned so lightly when it is known that I have given much thought to the modern philosophy and that I have spent much time in physical experiments and geometric demonstrations and was for a long time convinced of the emptiness of these beings to which I am at last compelled to return in spite of myself and as by force. This is after I have myself carried out studies which convinced me that our moderns do not do enough justice to St. Thomas and other great men of his time and that the opinions of the Scholastic philosophers

and theologians are much sounder than has been imagined, provided that they are used appropriately and in their proper place. I am even convinced that, if some exact and thoughtful mind were to take the pains to clarify and to assimilate their thoughts after the manner of the analytic method of geometricians, he would find a great treasure of very important and strictly demonstrative truths.

12. But to take up the thread of my considerations again, I believe that anyone who will meditate about the nature of substance as I have explained it above will find[353] that the entire nature of the body does not consist merely in extension, that is to say, in size, figure, and motion, but that there must necessarily be recognized in it something related to souls, which is commonly called a substantial form, although this form makes no change in the phenomena, any more than does the soul of beasts if they have one. It can even be demonstrated that the concepts of size, figure, and motion are not so distinct as has been imagined and that they include something imaginary and relative to our perceptions, as do also (though to a greater extent) color, heat, and other similar qualities which one may doubt truly are found in the nature of things outside of ourselves.[354] This is why qualities of this kind cannot constitute any substance. And if there is no other principle of identity in body than those we have just mentioned, no body can ever subsist longer than a moment.[355] Meanwhile the souls and the substantial forms of the other bodies are very different from intelligent souls, who alone know their actions and who not only never perish naturally but even preserve always the fundamental knowledge of what they are. This makes them alone susceptible of punishment and reward and citizens of the commonwealth of the universe of which God is the monarch. It follows also that all the other creatures should serve them; a matter which we shall discuss more fully later.

13. But before we go further we must try to meet a great difficulty which may grow out of the foundations which we have laid above. We have said that the concept of an individual substance once

and for all includes everything which can ever happen to it and that, in considering that concept, one can see everything which can truly be predicated of it, just as we can see in the essence of the circle all the properties which can be deduced from it. But it seems that this will destroy the distinction between contingent and necessary truths, that it will leave no place for human liberty, and that an absolute fatalism will rule over all our actions as well as over the other events of the world. To this I reply that we must distinguish between what is certain and what is necessary. It is universally agreed that future contingents are certain, since God foresees them, but this does not make us say that they are necessary. But someone may object that, if a certain conclusion can be deduced infallibly from a given definition or concept, that conclusion will be necessary. And we are now maintaining that everything that happens to some person is already contained virtually in his nature or concept, just as the properties of the circle are contained in its definition. Thus the difficulty still subsists. To answer it squarely, I say that there are two kinds of connection or sequence. One is absolutely necessary, for its contrary implies a contradiction, and this deductive connection occurs in eternal truths like those of geometry. The other is necessary only *ex hypothesi*, and by accident, so to speak, and this connection is contingent in itself when its contrary implies no contradiction. A connection of this kind is not based on pure ideas and on the simple understanding of God but also on his free decrees and on the sequence of events in the universe. Let us take an example. Since Julius Caesar is to become perpetual dictator and master of the republic, and will destroy the liberty of the Romans, this action is contained in his concept, for we have assumed that it is the nature of such a perfect concept of a subject to include everything, so that the predicate is included in it—*ut possit inesse subjecto*. One could say that it is not by virtue of this concept or idea that he must commit this act, since the concept fits him only because God knows everything. But, someone will insist, his nature or form corresponds to this concept, and, since

God imposed this personality upon him, it is henceforth necessary for him to fulfil it. I could reply by pointing out the case of future contingents, which as yet have reality only in the understanding and the will of God; but, since God has given them this form in advance, it is all the same necessary for them to respond to it. But I prefer to meet difficulties rather than to extenuate them by pointing out certain other similar difficulties, and what I am about to say will serve to clear up the one as well as the other. It is here, then, that we must apply the distinction we have made between the classes of connections, and I say that whatever happens in conformity to these divine anticipations is assured but not necessary and that, if anyone were to do the contrary, he would not do anything impossible in itself, though it would be impossible, ex hypothesi, for it to happen. For if some man were able to carry out the complete demonstration by virtue of which he could prove this connection between the subject, who is Caesar, and the predicate, which is his successful undertaking, he would actually show that the future dictatorship of Caesar is based in his concept or nature and that there is a reason in that concept why he has resolved to cross the Rubicon rather than stop there, and why he has won rather than lost the day at Pharsalus, and why it was reasonable and consequently assured that this should happen. But this man could not show that these events are necessary in themselves or that their contrary implies a contradiction. In the same way it is reasonable and assured that God will always do what is best, even though what is less perfect implies no contradiction. For it will be found that this demonstration of the predicate of Caesar is not as absolute as that of numbers or of geometry but that it supposes the sequence of things which God has freely chosen and which is founded on the first free decree of God, which leads him always to do what is most perfect, and on the decree which God has made about human nature (following the primary one), which is that man shall always do, though freely, that which appears to him to be best. But every truth which is based on this kind of a decree is contingent, even though it is certain, for these decrees do not change the possibility of things. And, as I have already said, though God assuredly always chooses the best, this does not prevent something less perfect from being and remaining possible in itself, even though it will never happen, for it is not its impossibility but its imperfection which causes God to reject it. Now, nothing is necessary whose opposite is possible. So we are in a position to meet difficulties of this kind, no matter how great they may seem (and, in fact, they are no less pressing for all the other thinkers who have taken up this matter), provided that we consider carefully that all contingent propositions have reasons for being as they are and not otherwise or, what amounts to the same thing, that they have a priori proofs of their truth which make them certain and which show that the relation between subject and predicate of these propositions has its basis in the nature of both. But we must consider too that these proofs are not demonstrations of necessity, since these reasons are based only on the principle of the contingency or of the existence of things, that is to say, on what is or appears to be the best among several equally possible things. Necessary truths, by contrast, are based on the principle of contradiction and on the possibility or impossibility of the essences themselves, without considering in this relation the free will of God or of the creatures.[356]

14. After having to some extent seen in what the nature of substances consists, we must try to explain the dependence they have on each other and their actions and their passions. Now it is clear, first of all, that the created substances depend on God, who preserves them and indeed even produces them continually by a kind of emanation, as we produce our thoughts. For as God turns the universal system of phenomena which he has seen fit to produce in order to manifest his glory, to all sides and in all ways, so to speak, and examines every aspect of the world in every possible manner, there is no relation which escapes his omniscience, and there thus results from each perspective of the universe, as it is seen from a certain position, a substance which expresses

the universe in conformity to that perspective, if God sees fit to render his thought effective and to produce that substance. And, since God's perspective is always true, our perceptions are also always true; it is our judgments, which come from ourselves, which deceive us.[357] But we have already said, and it follows from what we have just said, that each substance is as a world apart, independent of everything outside of itself except God. Thus all our phenomena, that is to say, all the things that can ever happen to us, are only the results of our own being. And, since these phenomena maintain a certain order which conforms to our nature or, so to speak, to the world which is within us, so that we are able to make observations that are useful for controlling our own conduct and justified by the success of future phenomena, with the result that we can often judge the future by the past without deceiving ourselves, this would be sufficient to enable us to say that these phenomena are true, without being put to the task of inquiring whether they are outside of us and whether others perceive them also. Nevertheless it is true that the perceptions or expressions of all substances intercorrespond, so that each one, following with care the established reasons or laws which it has observed, meets with others who have done this also. When a number of people have agreed to meet together in some place on a previously determined day, they can do this successfully if they wish. But, although all express the same phenomena, it does not follow from this that their expressions are exactly alike; it suffices that they are proportional. So a number of spectators believe that they see the same thing and are in fact in agreement about it, although each one sees and speaks of it according to the measure of his own point of view. It is only God (from whom all individuals emanate continually and who sees the universe not only as they see it but also entirely differently from all of them), who is the cause of this correspondence between their phenomena and who makes public to all that which is peculiar to one; otherwise, there would be no interconnection.[358] We might say, then, in a way, and with good meaning, though not in accordance with common usage, that one particular substance never acts upon another particular substance, nor is it acted upon by it, if we keep in mind that what happens to each is solely the result of its own complete idea or concept, since this idea already includes all the predicates or events and expresses the whole universe. Nothing can in fact happen to us except throughts and perceptions, and all our future thoughts and perceptions are only the consequences, however contingent they may be, of our preceding ones, so that, if I were capable of considering distinctly everything that is happening to me or appearing to me at this hour, I could see in it everything which will ever happen or appear to me. And this would not fail to happen to me, even if all that there is outside of me were to be destroyed, provided there remained only God and myself. But, since we do attribute to other things as causes acting upon ourselves that which we perceive in a certain way, we must consider the basis of this judgment and the element of truth which it has in it.

15. To reconcile the language of metaphysics with that of practice, it will suffice for the present, without entering into a long discussion, to remark that we ascribe to ourselves, primarily and with reason, those phenomena which we express more perfectly and that we attribute to other substances those phenomena which each expresses best. Thus a substance which has an infinite extension, insofar as it expresses everything, becomes limited because of an element of more or less in the perfection of its expression. It is in this sense, then, that we can think of substances as impeding and limiting each other, and consequently it is in this sense that we can say that they act upon each other and are obliged, so to speak, to adapt themselves to each other. For it can happen that a single change which increases the expression of one will diminish that of another. Now it is the virtue of a particular substance to express well the glory of God, and, the better it expresses it, the less limited it is. And whenever anything exercises its virtue or power, that is to say when it acts, it improves and enlarges it-

self in proportion to its action. Therefore, when a change takes place by which a number of substances are affected (as a matter of fact, every change affects them all), I believe it can be said that any substance which thereby passes immediately to a greater degree of perfection or to a more perfect expression exercises its power and acts, while any substance which passes to a lesser degree of perfection shows its weakness and suffers. I hold too that every action of a substance which has perception involves some pleasure, and every passion some pain, and vice versa. Yet it may well happen that a present advantage may be destroyed by a greater evil in the future, so that one can sin in acting or in exercising his power and in finding pleasure.

16. For the present it remains for me only to explain how God can sometimes influence men and other substances through an extraordinary and miraculous intervention, since it seems that nothing can happen to them which is extraordinary or supernatural, inasmuch as all events are only consequences of their own nature. But we must remember what we have said above concerning miracles occurring in the universe—that they always conform to the universal law of general order, even though they may be above the subordinate rules. Since every person or substance is like a little world which expresses the great one, we can say equally that this extraordinary action of God upon this substance is always miraculous, though it is included in the general order of the universe insofar as that order is expressed by the essence or individual concept of this substance. Therefore there is nothing supernatural in us, if we include in our nature everything which it expresses, for it extends to everything, since an effect always expresses its cause and since God is the true cause of the substances. But that which our nature expresses more perfectly belongs to it in a particular way, because it is in this expression that its power consists; yet this power is limited, as I have just explained. There are therefore many things which surpass the powers of our nature and even the powers of all limited natures. To speak more clearly, therefore,

I say that the miracles and extraordinary interventions of God have this peculiarity—that they cannot be foreseen by the reasoning of any created spirit, no matter how enlightened, because the distinct understanding of the general order is beyond all such spirits. Everything which is called natural, on the other hand, depends on less general maxims which creatures can understand. In order, then, that my words as well as my meaning may be beyond criticism, it is convenient to adapt certain ways of speech to certain thoughts. We can therefore define our essence or idea as that which includes everything which we express. And, since our substance expresses our union with God himself, it has no limits, and nothing is beyond it. But whatever is limited in us could be called our nature or our power, and, in this sense, whatever surpasses the natures of all created substances is supernatural.

17. I have already made frequent mention of subordinate rules or of the laws of nature, and it seems desirable to give an example of these. Our new philosophers commonly make use of the famous rule that God always conserves the same quantity of motion in the world. This rule is indeed most plausible, and I have in the past regarded it as beyond doubt. But more recently I have discovered wherein it is in error. This is that Descartes and many other able mathematicians believed that the quantity of motion, that is, the velocity multiplied by the magnitude of the moving body, coincides exactly with the moving force; or, to speak geometrically, that the forces are proportional to the product of velocities and masses.[359] Now it is reasonable that the same force should always be conserved in the universe. Also, when we attentively observe the phenomena, it is clear that perpetual mechanical motion cannot occur, because then the force of a machine, which is always diminished a little by friction and must therefore soon come to an end, would restore itself and consequently increase itself without any new impulsion from without. We observe also that the force of a body is only diminished in proportion as it imparts force to some bodies contiguous to it or to its own parts insofar as they have a

separate movement. So these mathematicians have thought that what can be said of force can also be said of the quantity of motion. But, to show that there is a difference, I make the *assumption* that a body falling from a certain height acquires the force to rise again to the same height if its direction carries it that way and if it meets with no obstructions. For example, a pendulum would rise again exactly to the height from which it has descended if air resistance and other small obstacles did not slightly diminish its acquired force. I make the further *assumption* that it takes as much force to lift a body *A* of 1 pound to the height *CD* of 4 fathoms as it takes to lift a body *B* of 4 pounds to the height of 1 fathom. All this is admitted by our new philosophers. It is clear, then, that, having fallen from the height of *CD*, the body *A* has acquired exactly as much force as the body *B* when it has fallen from the height *EF* (see No. 34, Fig. 11, p. 456). For the body *B*, having fallen to *F* and possessing at this point the force to rise again to *E* (by my first assumption) has therefore enough force to lift a body of 4 pounds, that is to say, itself, to the height *EF* of 1 fathom; and, similarly, the body *A*, having fallen to *D* and having at this point enough force to rise to *C*, has the power to lift a body of 1 pound, that is, itself, to the height *CD* of 4 fathoms. Then (by the second assumption) the force of these two bodies is equal. Let us see now if the quantity of motion is also equal in the two bodies; here we shall be surprised to find a very great difference. For, as Galileo has demonstrated, the velocity acquired by the fall *CD* is twice the velocity acquired by the fall *EF*, though the height is four times as big. Then if we multiply the body *A* (equal to 1) by its velocity (equal to 2), the product or the quantity of motion will be equal to 2; on the other hand, if we multiply the body *B* (equal to 4) by its velocity (which is equal to 1), the product or quantity of motion will be equal to 4. So the quantity of motion of the body *A* at the point *D* is half the quantity of motion of the body *B* at the point *F*; yet their forces are equal. Thus there is a great difference between quantity of motion and force, which was to be proved. We may see from this that force must be estimated by the quantity of the effect which it can produce, for example, by the height to which a heavy body of a certain size and kind can be lifted; and this is quite different from the velocity which can be imparted to it. To give it double its velocity, more than double the force is necessary. Nothing is simpler than this proof, and Descartes has fallen into error here only because he had too much confidence in his thoughts even when they were not yet sufficiently mature. But I am surprised that his disciples have not since discovered this error. I fear that they are beginning little by little to imitate certain of the Peripatetics whom they ridicule, like them gradually acquiring the habit of consulting the books of their master rather than reason and nature.

18. This consideration, in which force is distinguished from quantity of motion, is of importance not only in physics and mechanics in finding the true laws of nature and the rules of motion, and even in correcting many errors in practice which have slipped into the writings of a number of able mathematicians, but also in metaphysics for the better understanding of the principles. For considering only what it means narrowly and formally, that is, a change of place, motion is not something entirely real; when a number of bodies change their position with respect to each other, it is impossible, merely from a consideration of these changes, to determine to which bodies motion ought to be ascribed, and which should be regarded as at rest, as I could show geometrically if I wished to stop now to do it. But the force or the immediate cause of these changes is something more real, and there is a sufficient basis for ascribing it to one body rather than to another. This, therefore, is also the way to learn to which body the motion preferably belongs. Now this force is something different from size, figure, and motion, and from this we can conclude that not everything which is conceived in a body consists solely in extension and its modifications, as our moderns have persuaded themselves. Thus we are compelled to restore also certain beings or forms which they have banished. And, although all particular phenomena

of nature can be explained mathematically or mechanically by those who understand them, it becomes more and more apparent that the general principles of corporeal nature and of mechanics themselves are nevertheless metaphysical rather than geometrical and pertain to certain forms or indivisible natures as the causes of what appears rather than to the corporeal or extended mass. This reflection is capable of reconciling the mechanical philosophy of the moderns with the caution of certain intelligent persons of good will who fear, with some reason, that we may withdraw too far from immaterial beings and thereby put piety at a disadvantage.

19. Since I do not like to accuse people wrongly, I make no charge against our new philosophers who claim to banish final causes from physics, but I am nonetheless obliged to confess that the consequences of this opinion seem to me to be dangerous, especially if I combine it with the view which I refuted at the beginning of this discourse, which seems to go the length of denying final causes entirely, as if God in acting had proposed no end or good whatever, or as if the good were not the object of his will. I hold, on the contrary, that it is exactly in this that the principle of all existences and of the laws of nature is to be sought, for God always aims at the best and the most perfect. I willingly admit that we are liable to deceive ourselves when we try to determine the ends or designs of God, but this is only when we seek to limit them to some particular design, thinking that he has had in view only one particular thing, when in fact he at the same time takes into consideration the whole. Thus it is a great abuse to believe that God made the world only for us, although it is very true that he made it in its entirety for us and that there is nothing in the universe which does not affect us and which does not also comply with the regard which he has for us, in accordance with the principles set forth above. Therefore when we see any good effect or some perfection which occurs or which ensues from the works of God, we can say with certainty that God has purposed it, for he does nothing by

chance and is not comparable to us, who sometimes fail to do what is good. Therefore, while overzealous politicians may deceive themselves by imagining too much subtlety in the designs of their princes, or while commentators may err in seeking more erudition in their author than he has, we cannot be mistaken in this or attribute too much reflection to this infinite wisdom, and there is no subject in which we need less to fear error, provided we limit ourselves to affirmations and avoid negative statements which limit the designs of God.

Anyone who sees the wonderful structure of animals will find himself forced to recognize the wisdom of the Author of all things. And I advise those who have any feeling of piety, and indeed of true philosophy, to keep away from the phrases of certain would-be free-thinkers who say that we see because we happen to have eyes but that eyes were not made for the purpose of seeing. If one seriously accepts these opinions which ascribe everything to the necessity of matter or to a certain chance (though both of these views should seem ridiculous to anyone who understands what we have explained above), it is difficult to acknowledge an intelligent Author of nature. For the effect must correspond to its cause and is even known best through a knowledge of its cause. It is unreasonable to introduce a sovereign intelligence as the orderer of things, and then, instead of making use of his wisdom, to employ only the properties of matter in explaining phenomena. This is as if a historian should try to explain the conquest of some important place by a great prince, by saying that it occurred because the small particles of gunpowder, set free by the contact of a spark, escaped with a velocity capable of pushing a hard and heavy body against the walls of the place, while the little particles which composed the bronze of the cannon were so firmly interlaced that this velocity did not force them apart; instead of showing how the foresight of the conqueror led him to choose suitable time and means, and how his power overcame all obstacles.

20. This reminds me of a beautiful passage by Socrates in

Plato's Phaedo which agrees most remarkably with my opinions on this point and seems to be directed expressly against our too materialistic philosophers. Hence I have been tempted to translate this account, although it is a little long. Perhaps this little sample will lead someone to select for us many of the other beautiful and sound thoughts which are found in the writings of this famous author.[360]

21. Now, since the wisdom of God has always been recognized in the detail of the mechanical structure of certain particular bodies, it must also be shown in the general economy of the world and in the constitution of the laws of nature. This is so true that one can observe the designs of this wisdom in the general laws of motion. For if there were nothing in bodies but extended mass, and nothing in motion but change of place, and if everything should and could be deduced solely from the definitions of these by geometric necessity, it would follow, as I have elsewhere shown, that the smallest body, in colliding with the greatest body at rest, would impart to it its own velocity, without losing any of this velocity itself; and it would be necessary to accept a number of other such rules which are entirely contrary to the formation of a system.[361] But the decree of the divine wisdom to conserve always the same total force and the same total direction has provided for this. I find even that several effects of nature can be doubly demonstrated; once, by the consideration of their efficient cause, and, again, independently, by the consideration of the final cause, making use, for example, of the decree of God always to produce his effect by the easiest and most determined ways, as I have shown elsewhere in accounting for the rules of catoptrics and dioptrics; I shall have more to say about this soon.[362]

22. It is convenient to make this comment in order to reconcile those who hope to explain mechanically the formation of the primary texture of an animal and the whole machinery of its parts, with those who account for this same structure through final causes. Both methods are good, both can be useful not only for admiring the

skill of the great workman but also for making useful discoveries in physics and in medicine. Authors who take these different routes ought not to abuse each other. For those who are intent on explaining the beauty of the divine anatomy, I observe, laugh at those who imagine that what seems to be a chance flow of certain liquids could have produced so beautiful a variety of parts and denounce them as rash and irreverent. And these latter, I observe also, treat the former in their turn as simple and superstitious, comparing them to the ancients who regarded the physicists as impious when they maintained that it is not Jupiter who thunders but some matter found in the clouds.[363] The best would be to combine the two points of view, for, if I be permitted to use a lowly comparison, I acknowledge and praise the skill of a workman, not only in showing the plans which he had in making the pieces of his machine, but also in explaining the tools which he has used in making each piece, especially when these tools are simple and cleverly contrived. And God is an artisan skilful enough to produce a machine a thousand times more ingenious than that of our bodies, by using nothing but certain rather simple fluids formed expressly in such a way that only the ordinary laws of nature are needed to give them the organization necessary to produce so admirable an effect. But it is true also that this would not happen if God were not the Author of nature. Yet I find that the way of efficient causes, which is in fact the profounder and in some ways the more immediate and a priori, is, on the other hand, rather difficult when one comes to details, and I believe that for the most part our philosophers are still far from mastering it. The way of final causes, however, is easier and is often useful for understanding important and useful truths, which one would be a long time seeking by the other more physical route; of this fact, anatomy can provide significant examples. I believe, too, that Snell, who first discovered the rules of refraction, would have waited a long time to find them if he had sought first to discover how light is formed. But apparently he followed the method which the ancients used in catoptrics, which is in fact that of final causes. For, seeking the easiest way in which to direct a ray from one given point to another through reflection by a given plane (assuming that the easiest way is the plan of nature), they discovered the equality of the angles of incidence and reflection, as one can see in a little treatise by Heliodorus of Larissa and elsewhere. This method, I believe, Snell, and later though independently of him Fermat, applied most ingeniously to refraction. For when rays in the same media observe a ratio between the sines which is equal to the ratio of the resistances of the media, this happens to be the easiest, or at least the most determined, way to pass from a given point in one medium to a given point in another. The demonstration which Descartes sought to give of this same theorem by the method of efficient causes is not nearly so good. At least we have grounds to suspect that he would never have found it by this method if he had not learned anything of Snell's discovery in Holland.[364]

23. I have found it proper to stress these considerations about final causes, incorporeal natures, and an intelligent cause in connection with bodies in order to show their usefulness even in physics and mathematics and thus to purge the mechanical philosophy, on the one hand, of the impiety with which it is charged and, on the other hand, to raise the spirit of our philosophers from exclusively material considerations to nobler meditations. Now it will be fitting to return from bodies to immaterial natures, and particularly to spirits, and to say something about the way God takes to enlighten them and to act upon them. We must not doubt that there are certain laws of nature here also, about which I could speak more fully elsewhere. At present it will suffice to say something about the doctrine of ideas, and whether we see all things in God, and the sense in which God is our light.[365] It may be observed appropriately that a wrong use of the ideas gives occasion for several errors. For, when one reasons about something, one imagines himself to have an idea of that thing, and this is the basis on which certain philosophers, ancient and modern, have built one of the dem-

onstrations of God which is most imperfect. For I must have an idea of God, they say, or of a perfect being, since I think of him, and one cannot think without an idea; now the idea of this being includes all perfections, and existence is one of these; therefore, he exists. But since we often think of impossible chimeras, for example, of the highest degree of speed, or the largest number, or the intersection of the conchoid with its base or asymptote, this reasoning is insufficient. In this sense, then, we can say that there are true and false ideas, according to whether the thing concerned is possible or not. So one can boast of having an idea of a thing only when one is assured of its possibility. Thus the argument given above at least proves that God exists necessarily, if he is possible. It is indeed an excellent privilege of the divine nature that it needs only its possibility or essence in order actually to exist, and this is precisely what we mean by an ens a se.

24. In order better to understand the nature of ideas, we must to some extent touch upon the various kinds of knowledge.[366] When I can recognize one thing among others but cannot say in what its differences or properties consist, my knowledge is confused. In this way we sometimes know clearly, and without having a doubt of any kind, if a poem or a picture is well done or badly, because it has a certain "something, I know not what" which either satisfies or repels us. But, when I can explain the criteria I use, my knowledge is called distinct. Of this kind is the knowledge of an assayer who distinguishes the true gold from the false by means of certain tests and marks which make up the definition of gold. But distinct knowledge has degrees, for usually the concepts which enter into the definition would themselves need definition and are known only confusedly. But when everything which enters into a definition or distinct knowledge is known distinctly, down to the primitive concepts, I call such knowledge adequate. And when my mind grasps all the primitive ingredients of a concept at once and distinctly, it possesses an intuitive knowledge. This is very rare, since for the most part human knowledge is merely confused and suppositive.

It is well also to distinguish nominal and real definitions. I call a definition nominal when it can still be doubted that the defined concept is possible. So, for example, if I say that an endless screw is a line in three dimensions whose parts are congruent or can be brought to coincide with each other, anyone who does not know from another source what an endless screw is could doubt whether such a line is possible, even though this is in fact one of the reciprocal properties of the endless screw, for the other lines whose parts are congruent to each other (there are only two, the circumference of a circle and the straight line) are plane figures, that is to say, they can be drawn in a plane. This shows us that every reciprocal property can serve as a nominal definition but that, when the property makes us understand the possibility of a thing, it establishes a real definition. As long as we have only a nominal definition, we cannot be sure of the consequences drawn from it, for, if it concealed some contradiction or impossibility, we could draw conflicting conclusions. This is why truths do not depend on names and are not arbitrary, as some modern philosophers have thought. Nevertheless, there is still a great difference between the kinds of real definitions, for, when possibility is proved only through experience, the definition is only real and nothing more; as in the definition of quicksilver, the possibility of which we recognize because we know that such a body, extremely heavy and yet rather volatile, is actually found. But when the proof of possibility is presented a priori, the definition is both real and causal, as when it contains the possible production of the thing. And when the definition pushes its analysis back to the primitive concepts without assuming anything which needs an a priori proof of its possibility, it is perfect or essential.

25. Now it is obvious that we have no idea of a concept when it is impossible. And in the case of merely suppositive knowledge, even if we may have an idea, we do not grasp that idea, for such a concept is known only in the same way as are those concepts which involve a hidden impossibility; even if it is possible, we cannot learn

of its possibility by this way of knowing. For example, when I think of the number 1,000, or of a regular polygon of a thousand sides, I frequently do it without grasping the idea; just as I do when I say that a thousand is 10 times 100, without taking the trouble to think of what 10 and 100 are, because I suppose that I know it and do not think it necessary to stop just at present to conceive them. So it may very well happen—as it does in fact often happen—that I am in error about a concept which I suppose or believe I understand, although it is in fact impossible, or at least incompatible with other concepts with which I combine it. And, whether I am in error or not, this suppositive way of forming concepts remains the same. It is therefore only when our knowledge of confused concepts is clear, and our knowledge of distinct concepts is intuitive, that we see their whole ideas.

26. In order properly to conceive correctly what an idea is, we must forestall an ambiguity, for several thinkers take the idea for the form or the differential of our thoughts, and thus we have an idea in our mind only insofar as we are thinking of it, and every time we think of it anew we have another idea of the same thing, though it is similar to the preceding ones. But others, it seems, take the idea to be an immediate object of thought, or for some permanent[367] form which remains even when we no longer contemplate it. As a matter of fact, our soul always does have within it the disposition to represent to itself any nature or form whatever, when an occasion arises for thinking of it. I believe that this disposition of our soul, insofar as it expresses some nature, form, or essence, is properly the idea of the thing, which is in us and is always in us whether we think of it or not. For our soul expresses God and the universe, and all the essences as well as all the existences. This is in accord with my principles, for nothing enters naturally into our minds from without, and it is a bad habit we have of thinking as if our soul received certain "species" as messengers and as if it had doors and windows.[368] We have all these forms in our own minds, and even from eternity, for at every moment the

mind expresses all its future thought and already thinks confusedly of everything of which it will ever think distinctly. Nothing can be taught us the idea of which is not already in our minds, as the matter out of which our thought is formed. This Plato has excellently recognized in proposing his doctrine of reminiscence, a well-founded doctrine provided it is taken rightly and purged of the error of pre-existence and provided that we do not imagine that the soul must already have known and thought distinctly at some past time about what it learns and thinks now. Plato has also confirmed his opinion by a beautiful test, introducing a small boy, whom he gradually guides toward the most difficult geometric truths about incommensurables without teaching him anything, but merely asking the appropriate questions in good order.[369] This shows that our soul knows all these things virtually and needs only to turn its attention to them to recognize truth, and therefore that it at least has the ideas upon which these truths depend. One may even say that it already possesses these truths, if we consider them as the relations between the ideas.

27. Aristotle preferred to compare our souls to tablets that are still blank but upon which there is a place for writing and maintained that there is nothing in our understanding which does not come from the senses. This conforms more with popular notions, as Aristotle usually does, while Plato goes deeper. Yet these kinds of formulas or practical commonplaces are allowed in ordinary usage, in about the same way as Copernicans continue to say that the sun rises and sets. I even find that such usages can often be given a good meaning, according to which they involve no falseness, in the same way that I have already shown in what sense we may truly say that particular substances act upon each other. In this same sense we can also say that we receive our knowledge from without through the ministry of the senses, because certain exterior things contain or express more particularly the reasons which determine our soul to certain thoughts. But, when the exactness of metaphysical truths is involved, it is important to recognize the compass and

independence of our soul, which reaches infinitely further than is popularly thought, even though we ascribe to it, in the language of ordinary life, only what is most manifestly perceived and what pertains to us more particularly, since under these conditions it serves no purpose to go further. It would be appropriate, nevertheless, to choose fitting terms for the two meanings, in order to avoid equivocation. So the expressions which are in the soul, whether conceived or not, can be called ideas, but those which are conceived or formed can be called notions or concepts. But, in whatever sense they are taken, it is always false to say that all of our notions come from the senses which are called external; for the notions which I have of myself and of my thoughts, and, consequently, of being, of substance, of action, of identity, and of many others, come from an internal experience.

28. In the rigorous sense of metaphysical truth there is no external cause which acts upon us except God alone, and he alone communicates himself to us immediately by virtue of our continual dependence upon him. Whence it follows that there is no other external object which affects our soul and immediately excites our perception. It is also only by virtue of the continual action of God upon us that we have in our soul the ideas of all things; that is to say, since every effect expresses its cause, the essence of our soul is a certain expression, imitation, or image of the divine essence, thought, and will and of all the ideas which are comprised in God. So it can be said that God alone is our immediate object outside of us and that we see all things through him; for example, when we see the sun and the stars, it is God who has given us and preserves in us the ideas of them and who determines us, through his ordinary concourse, actually to think of them at the moment when our senses are set in a certain manner, in conformity with the laws which he has established. God is the sun and the light of souls—lumen illuminans omnem hominem venientem in hunc mundum;[370] and this opinion has not been invented only today. In addition to the Holy Scriptures and the Fathers, who were always

more Platonists than Aristotelians, I recall having observed long ago that, at the time of the Scholastics, several believed that God is the light of the soul and, as they put it, the intellectus agens animae rationalis.[371] The Averroists gave this a bad turn of meaning, but others, among them William of Saint Amour, I believe, and several mystical theologians, understood it in a way worthy of God and capable of elevating the soul to a knowledge of its true good.

29. I am not of the opinion of certain able philosophers, however, who seem to hold that our ideas themselves are in God and not at all in us. In my opinion this results from their failure adequately to consider the nature of substances as we have here explained it, and the full compass and independence of the soul, which includes all that happens to it and expresses God and with him all actual and possible beings as an effect expresses its cause. It is also inconceivable that I should think by means of the ideas of someone else. The soul, too, must actually be affected in a certain way, when it is thinking of something, and must therefore have within it, in advance, not merely a passive power of being thus affected, a power already entirely determined, but also an active power by virtue of which it has always had, within its own nature, marks of the future production of this thought and the disposition to produce it at the proper time. All this already enfolds the idea embraced in this thought.[372]

30. As for the action of God upon the human will, this involves many rather difficult problems which it would take too long to pursue here. Yet these rough indications may be given. In concurring with our actions, God ordinarily follows only the laws which he has established, that is to say, he continually preserves and produces our being in such a way that our thoughts come to us spontaneously or freely in the order which the concept of our individual substance implies. In this concept it was possible to foresee them from all eternity. Furthermore, by virtue of the decree which he has made that the will shall always strive toward the apparent good, by expressing or imitating God's will under certain particular conditions

(with respect to which this apparent good always is to some extent a true good), God determines our will to choose what seems to be the best, but without constraining it. For in an absolute sense the will is in a state of indifference, insofar as this is the opposite of necessity, and it has the power to act otherwise or also to suspend its action entirely, since both alternatives are and remain possible. It rests with the soul, therefore, to guard itself against surprises coming from appearances by means of a firm will, to reflect, and not to act or judge in certain circumstances until after careful and mature deliberation. It is nonetheless true and, indeed, even assured from all eternity that a certain soul will not make use of this power in such circumstances. But whose fault is that? Can the soul complain of anyone but itself? For all such complaints made after the deed are unjust, if they would have been unjust before the deed as well. Could this soul, just before sinning, in good faith complain of God as if he determined it to sin? Since the determinations of God in such matters cannot be foreseen, how can the soul know that it is determined to sin unless it is already sinning in fact? It is merely a question of not willing, and God could not grant an easier and juster condition. So, too, all judges consider only the question of how evil a man's will is, without seeking the reasons which have disposed him to have an evil will. But can it be that it is assured from all eternity that I shall sin? Answer this for yourselves; perhaps it is not. So instead of musing on what you cannot know and what cannot give you any light, act according to the duty which you know. But, someone else may say, how does it come that this man will certainly commit this sin? The reply is easy; it is that otherwise he would not be this man. For God foresees from all time that there will be a certain Judas, whose idea or concept which God has contains this future free act. There remains then only this question: Why does such a Judas, a traitor, who is merely possible in the idea of God, actually exist? But to this question no answer can be expected here on earth, except the general one that, since God has found it good that he should exist in spite of the sin which God foresaw, this evil must be compensated for with interest in the universe and that God will draw a greater good from it and that it will turn out finally that this sequence of events, including the existence of this sinner, is the most perfect among all other possible kinds. But, as long as we are sojourners in this world, it will be impossible always to explain the admirable economy of this choice; it is enough to know it without understanding it. Here it is time to acknowledge the height of the riches, the depth and the abyss, of the divine wisdom, without seeking a detail which involves infinite considerations.

It is well understood, however, that God is not the cause of evil. For it is not only after man's fall from innocence that original sin has got hold of the soul; even before, there was an original limitation or imperfection connatural to all creatures, which makes them capable of sin or failure. There is therefore no greater difficulty in supralapsarianism than in other views. And to this, I believe, the opinion of St. Augustine and other authors should be reduced who hold that the root of evil lies in nothingness, that is, in the privation or limitation of creatures, which God graciously corrects by that degree of perfection which it pleases him to give. This grace of God, whether ordinary or extraordinary, has its degrees and measures; in itself it is always efficacious in producing a definite proportional effect, and, furthermore, it is always sufficient not only to protect us from sin but even to accomplish salvation, provided that man meets it with his own powers. But it is not always sufficient to surmount the inclinations of man, for otherwise he would have nothing more to strive for, and this is reserved solely for the absolutely efficacious grace which is always victorious, whether through itself or through the congruity of circumstances.

31. Finally, God's acts of grace are those of an entirely pure grace, and creatures have no claim upon them. Yet, in accounting for the choices which God makes in dispensing his grace, it is not enough to have recourse to his absolute or conditional foresight into the future actions of men. Just so it is also a mistake to imagine

absolute decrees without any reasonable motive. As for God's foreknowledge of faith and good works, it is most true that God has elected only those whose faith and charity he has foreseen, quos se fide donaturum praescivit.[373] But the same question once more arises: Why will God give the grace of faith and good works to some rather than to others? As for this knowledge of God, which is the foresight not of man's faith and good deeds but of the material and predisposition for them, or that which man on his part would contribute, it seems to some that one might say that God, seeing what man would do without grace or extraordinary help, or at least what man would contribute on his side apart from grace, might resolve to bestow his grace upon those who have the best natural dispositions or, at any rate, the least imperfect and evil dispositions. For there are diversities on the side of man as truly as on the side of grace; man needs, indeed, to be aroused to the good and converted, but he must also act afterward in this direction. But, if this be so, it could still be said that these natural dispositions, insofar as they are good, are still the effect of a grace, though of ordinary grace, God having favored some more than others. And since he very well knows that these natural advantages which he gives will serve as motives of his extraordinary grace or assistance, is it not true according to this doctrine that eventually everything is reduced entirely to his mercy? I think therefore that, since we do not know how much and in what way God takes into consideration the natural dispositions in dispensing his grace, it will be most exact and certain to say, in accordance with our principles and as I have already said, that among the possible beings there must be that person Peter or John whose concept or idea contains the entire sequence of grace, ordinary and extraordinary, along with all the other events and their circumstances, and that it has pleased God to choose this one person for actual existence among an infinity of other equally possible persons. With this it seems to me that all questions are answered and all difficulties have vanished.

As for the one great question of why it has pleased God to choose one out of so many other possible persons, it would be very unreasonable not to be content with the general reasons which we have given, since the details lie beyond us. So instead of having recourse to an absolute decree which is unreasonable, since it has no reason, or to reasons which do not solve the difficulty completely and need further reasons themselves, it will be best to say, with St. Paul, that in this God has obeyed certain great counsels of wisdom or of congruity unknown to mortals and based on the general order whose end is the greatest perfection of the universe. It is to this that are reduced the motives of the glory of God, of the manifestation of his justice as well as his mercy and of his perfections in general, and, finally, that immense depth of his riches with which the soul of St. Paul himself was so transported.[374]

32. For the rest, it seems that, far from harming religion, the thoughts which we have just presented—particularly the great principle of the perfection of God's works and that of the concept of substance which includes all its experiences along with the circumstances under which they occur—serve rather to confirm it, to dissipate very great difficulties, to inflame souls with a divine love, and to elevate spirits to the knowledge of the incorporeal substances much better than do the hypotheses which we have seen until now. For it appears most clearly that all the other substances depend on God as our thoughts emanate from our substance, that God is all in all, that he is closely united with all his creatures, yet in proportion to their perfection, and that it is he alone who determines them from without through his influence. If to act means to determine immediately, then it can be said in this sense, in the language of metaphysics, that only God acts upon me and only he can do good or evil to me, all other substances contributing only in proportion to these determinations, since God, who takes them all into consideration, distributes his goodness and compels all substances to adjust themselves to each other. So only God, also, constitutes the link or communication between the substances, and it is through him that the phenomena of the one meet with and agree

with those of the others and that consequently there is reality in our perceptions. In practice, however, action is attributed to particular reasons in the sense which I have explained above, because it is not necessary always to mention the universal cause in particular cases. We see also that every substance has a perfect spontaneity, which becomes freedom in the intelligent substances, that everything which happens to it is the result of its idea or its being, and that nothing determines it save God alone. It is for this reason that a person of exalted spirit, revered for his saintliness, was wont to say that the soul should often think as if only God and itself were in the world. Nothing can give us a stronger understanding of immortality than this independence and compass of the soul, which protects it absolutely from all external things, since it alone makes up its own world and is self-sufficient with God. And it is as impossible for the soul to perish, except by annihilation, as it is for the world (of which it is a living, perpetual expression) to destroy itself. It is therefore impossible that the changes in this extended mass which is called our body could affect the soul in any way, or that the decomposition of the body could destroy that which is indivisible.

33. We are thus unexpectedly brought to a clear insight into the great mystery of the union of body and soul, that is to say, how it happens that the passions and actions of the one are accompanied by the actions and passions, or their corresponding phenomena, in the other. For there is no way in which we can conceive of an influence[375] of the one on the other, and it is unreasonable simply to have recourse to the extraordinary operation of the universal cause in so ordinary and particular a thing. But the true principle is this: We have said that everything which happens to the soul and to each substance follows from its concept; hence the idea itself, or the essence of the soul, carries with it that all its appearances or perceptions must arise spontaneously out of its own nature and in just such a way that they correspond, by themselves, to what happens in the entire universe but more particularly and more perfectly to what

happens in the body which is assigned to it. For the soul expresses the state of the universe only in a particular way and at a definite time, according to the relation of other bodies to its own. This shows us also how our body belongs to us without being attached to our essence.[376] I believe that those who have the gift of meditation will judge favorably of our principles for the single reason that they will be able to realize easily in what consists the connection between the soul and the body which seems inexplicable in any other way. We see also that our sense perceptions, even when they are clear, must necessarily contain a certain confused feeling, for, since all the bodies of the universe are in sympathy with each other, ours receives impressions from all the rest, and, though our senses are in response to all of them, it is impossible for our soul to pay attention to every particular impression. This is why our confused sensations result from a really infinite variety of perceptions. This is somewhat like the confused murmur heard by those who approach the seashore, which comes from the accumulation of innumerable breaking waves. For if out of several perceptions, which do not harmonize so as to make one, there is no single one which surpasses the others, and if these perceptions make impressions that are about equally strong and equally capable of holding the attention of the soul, it can perceive them only confusedly.

34.[377] Assuming that the bodies which make up a _unum per se_, for example, man, are substances and that they have substantial forms, and assuming that beasts have souls, we must admit that these souls and substantial forms cannot entirely perish any more than can atoms or the ultimate parts of matter in the opinions of other philosophers. For no substance perishes, although it may become entirely different. Those substances, too, express the whole universe, although more imperfectly than do the spirits. But the chief difference is that they do not know what they are or what they do, and since, consequently, they cannot reflect, they are unable to discover necessary and universal truths. It is also because they lack reflection about themselves that they have no moral quality.[378] Hence, though animals may pass through a thousand transformations like that which we see when a caterpillar changes into a butterfly, yet from the moral or practical point of view the result is just as if they had perished; indeed, one may even say that they have perished in a physical sense, that is, in the sense in which we say that bodies perish through their corruption. But the intelligent soul, knowing what it is and being able to say this little word "I" which means so much, not merely remains and subsists metaphysically (which it does in a fuller sense than the others) but also remains the same morally and constitutes the same character. For it is memory or the knowledge of this "I" which makes it capable of punishment and reward. Likewise, the immortality which is demanded in morals and religion does not consist merely in this perpetual subsistence which is common to all substances, for, without a memory of what one has been, there would be nothing desirable about it. Suppose some private man should suddenly become king of China, but only on condition that he forget what he had been, just as if he were being born anew; would it not be the same practically, or so far as discernible effects are concerned, if he were annihilated and a king of China created at the same instant in his place? This particular man has no reason whatever to desire this.

35. But in order to support by natural reasons the view that God will preserve for all time not merely our substance but also our person, that is to say, the memory and knowledge of what we are (though the distinct knowledge is sometimes suspended in sleep and in fainting fits), we must add morals to metaphysics. That is to say, we must consider God, not only as the principle and cause of all substances and all beings, but also as the head of all persons or intelligent substances and as the absolute monarch of the most perfect city or state, such as is the universe composed of all the spirits together, God himself being the most perfect of all spirits, as well as the greatest of all beings. For certainly spirits are the most perfect of beings and those which best express the divine being. And since the whole nature, end, power, and function of sub-

stance is merely to express God and the universe, as we have explained at length, there is no reason to doubt that those substances which express him with a knowledge of what they are doing, and which are capable of knowing the great truths about God and the universe, express him better beyond all comparison than do those natures which are either brutish or incapable of knowing truth or entirely destitute of feeling and knowledge. Moreover, the difference between the intelligent substances and those which have no intelligence at all is just as great as that between a mirror and one who sees. And since God himself is the greatest and wisest of spirits, it is easy to understand that the beings with whom he can enter into conversation, so to speak, and even into a society, communicating his opinions and his will to them in a particular manner and in such a way that they can recognize and love their benefactor, must be infinitely nearer to him than all other things which can pass only for the instruments of spirits. So we see that all wise persons value man infinitely more highly than any other thing, no matter how precious, and it seems that the greatest satisfaction that a soul can have, which is content in other respects, is to see itself loved of others. However there is this difference with respect to God—the glory and the worship which we offer cannot add to his satisfaction, since the knowledge of creatures is only a result of his sovereign and perfect happiness, far from contributing to it or being a partial cause of it. However, whatever is good and reasonable in finite spirits is found pre-eminently in him. And just as we would praise a king who prefers to save the life of one man above that of his rarest and most precious animal, so we cannot doubt that the most enlightened and most just of all monarchs is of the same opinion.

36. Spirits are indeed the most perfectible of substances, and their perfections have the particular advantage of interfering with each other in the least possible degree, or rather of supporting each other, for only the most virtuous can be the most perfect friends. Hence it obviously follows that God, who always aims at the great-

est general perfection, will have the greatest concern for spirits and will give to them, not only in general but to each one in particular, the greatest degree of perfection which the universal harmony can permit. It can even be said that God, insofar as he is a spirit, is the origin of existences, for otherwise, if he had lacked the will to choose the best, there would be no reason why one possible being should exist in preference to others. So this property of God's being himself a spirit comes before all other considerations which he may have with regard to the creatures. Only spirits are made in his image and are, as it were, of his blood or like the children of his household, for only they can serve him freely and act with knowledge in imitation of the divine nature. One single spirit is worth a whole world, because it not only expresses the world but also knows it and conducts its life there after the manner of God. So it seems that though every substance expresses the whole universe, yet the other substances express the world rather than God, while the spirits express God rather than the world. This nature of spirits, so noble that they approach divinity as closely as is possible for simple creatures, brings it about that God derives infinitely more glory from them than from all the other beings or rather that the other beings merely provide spirits with matter for glorifying him. This is why this moral nature of God, which makes him the lord and monarch of spirits, is of a quite singular concern to God personally, if we may say so. It is in this relation that he humanizes himself, that he is willing to tolerate anthropomorphisms, and that he enters into a society with us, as a prince with his subjects. So dear is this consideration to him that the happy and flourishing state of his Empire, which consists in the greatest possible felicity of its inhabitants, becomes his highest law.[379] For happiness is to persons what perfection is to beings. And if the highest principle ruling the existence of the physical world is the decree which gives it the greatest perfection possible, the highest purpose in the moral world, or the city of God which is the noblest part of the universe, should be to spread in it the greatest possible happiness. It must not be doubted, therefore, that God has ordered everything in such a way not only that spirits can live forever, which is inescapable but also that they shall forever preserve their moral status, in order that no person may be lost to the city, just as no substance is lost to the world. As a result they will always know what they are, otherwise they would be incapable of reward and punishment, both of which are essential in a republic and especially in the most perfect one where nothing can be overlooked. Finally, since God is at the same time the most just and the most benevolent of monarchs and demands only a good will, provided it be sincere and serious, his subjects cannot desire a better state. To make them perfectly happy, he asks only that they love him.

37. The ancient philosophers knew very little about these important truths. Only Jesus Christ has expressed them divinely well and in a manner so clear and simple that the dullest spirits have grasped them. His gospel has thus entirely changed the aspect of human affairs; it has revealed to us the kingdom of heaven or that perfect republic of spirits which deserves the title of the city of God, the admirable laws of which he has revealed to us. He alone has made us see how much God loves us and with what exactness he has provided for all that concerns us; how God who cares for the sparrows will not neglect the reasonable creatures who are infinitely more dear to him; how all the hairs on our head are counted; how heaven and earth may pass away, but the word of God and all that pertains to the economy of our salvation shall endure; how God has more concern for the least of these intelligent souls than for the whole world-mechanism; how we ought not to fear those who can destroy the body but cannot do any harm to the souls, since only God can make the souls happy or wretched; and how the souls of the righteous are protected by his hand against all the revolutions of the world, since nothing can act upon them save God alone; how none of our acts is forgotten but everything is placed on account, even idle words and a well-used spoonful of water; finally, how everything works for the greatest good of those who are good, and

the righteous shall be as suns, so that neither our sense nor our spirit has ever tasted anything approaching the happiness which God has prepared for those who love him.

36

Correspondence with Arnauld

1686-87

(Selections)

In February, 1886, Leibniz sent to Count Ernest of Hesse-Rheinfels a summary of his "petit discours de métaphysique" in thirty-seven propositions, to be transmitted to Antoine Arnauld for his criticism. The latter entered into correspondence with Leibniz reluctantly, seizing upon one proposition, No. 13, only, for his criticism:

> Since the individual concept of each person contains once for all everything that will ever happen to him, one may see in it a priori the proofs or reasons for the truth of every event, or why one thing happens rather than another. But, however certain they may be, these truths are nonetheless contingent, being founded on the free will of God and of creatures. It is true that there are always reasons for their choice, but these reasons incline without necessitating.

In his letter to Ernest of March 13, 1686, Arnauld found this view frightening and without utility, since it implied a "necessity more than fatal." Beginning with the problem of individual freedom, the correspondence roughly falls into two parts. In the first Leibniz at length wins a qualified assent to his proposition; in the second the discussion is extended to the more general issues such as the nature of "concomitance" or harmony, the role of expression in sustaining it, and the interpretation of substance, particularly material substance. The important concluding letters from each part—those of July 14, 1686, and of October 9, 1687—are here translated. Arnauld's criticisms are sufficiently clear from Leibniz's carefully stated replies. The latter's Italian journey closed the correspondence in 1687, though he tried without success to renew it in 1690 (Vol. II, No. 38).

* * *

I

[G., II, 47-59]

July 14, 1686[380]

Since I have great deference for your judgment, I was happy to see that you have moderated your criticism after seeing my explanation of the proposition which I regard as important but which you found strange: that "the individual concept of each person contains once and for all everything that will ever happen to him." From it you at first concluded that, from the single assumption that God resolved to create Adam, all the remaining human events which happened to Adam and to his posterity followed by a fatal necessity, so that God would no longer have the freedom to control them any more than he could have failed to create a creature capable of thought after he had made the decision to create me.

To this I replied that, since the designs of God which concern this whole universe are all interrelated in conformity with his sovereign wisdom, he made no decision about Adam without taking into consideration everything which has any connection with him. It is therefore not because of the decision made about Adam but because of the decision made at the same time about everything else (to which the decision made about Adam involves a perfect relation) that God makes up his mind about all human events. There seems to me no fatal necessity in this, or anything contrary to God's freedom, any more than in the generally accepted hypothetical necessity to which God himself is subject, of carrying out what he has resolved.

In your reply, Sir, you agree with this relationship which I have proposed between the divine decisions, and you even admit sincerely that at first you understood my proposition in an entirely different sense, because it is not customary, for example (these are your words), to consider the specific concept of a sphere by its relation to that which it is represented to be in the divine mind but by the relation to what it is in itself, and you believed (I admit with good reason) that this is also true in the case of the individual concept of each person.

I, for my part, have thought that the full and comprehensive concepts are represented in the divine mind as they are in themselves.[381] But now that you know that this is my opinion, this will suffice for you to accept it as such and to examine whether it removes the difficulty. You seem then to recognize, Sir, that, explained in this way, my opinion about full and comprehensive concepts such as are found in the divine mind is not only free from offense but even right. For these are your words:

> I agree that the knowledge which God had of Adam when he resolved to create him includes a knowledge of everything that has happened to him and everything that has happened or will happen to his posterity, and that, taking the individual concept of Adam in this sense, what you say is most certain.[382]

We shall soon see in what the difficulty which you still find here consists. Meanwhile I shall say a word about the reason for the difference that exists here between the concepts of species and those of individual substances with respect to the divine will rather than to simple understanding. This difference is that the most abstract concepts of species contain only necessary or eternal truths which do not at all depend on the decrees of God (although the Cartesians say they do, you yourself do not seem to be concerned about this point). But the concepts of individual substances, which are complete and suffice to distinguish their subjects completely, and which consequently inclose contingent truths or truths of fact, and individual circumstances of time, place, etc., must also inclose in their concept taken as possible the free decrees of God, also viewed as possible, because these free decrees are the principal sources of existences or facts. Essences, on the other hand, are in the divine understanding prior to any consideration of the will.

This will help us better to understand everything else and to satisfy the difficulties which seem still to remain in my explanation. For you continue as follows:

> But it seems to me that it still remains to ask—and it is here that my difficulty lies—whether the connection between these objects (I mean Adam and human events) is such in itself independently of all the free decrees of God, or whether it is dependent upon them. In other words, whether it is only as a result of these free decrees by which God has ordained everything that will happen to Adam and to his posterity that God knows everything that will happen to them, or whether there is an intrinsic and necessary connection between Adam, on the one hand, and all that has happened and will happen to him and his posterity, on the other, independently of these decrees.

It seems to you that I choose the second alternative, because I have said that "God has found, among the possible ones, an Adam with such individual circumstances and who has among his other predicates also that of having such a posterity in the course of time."

You assume, now, that I will agree that possibilities are possible before all the free decrees of God. Assuming then that this explanation of my meaning follows the second alternative, you conclude that it contains insurmountable difficulties.

> For (as you say quite rightly) there is an infinity of human events which happen through particular ordinances of God, such, for example, as the Jewish and the Christian religions, and especially the incarnation of the divine Word. And I do not see how one can say that all this (which has happened by the very free decrees of God) was included in the individual notion of the possible Adam. He who is considered as possible must have everything which he is conceived to have according to this concept, independently of the divine decrees.

I have tried to report your difficulty exactly, Sir, and now hope to meet it completely even to your satisfaction. For it must have a solution, since we cannot deny that there is truly such a full notion of Adam, accompanied by all his predicates and conceived as possible, and that God knows this before he decides to create him, as you have agreed. But I believe that the dilemma of the twofold explanation which you propose is not exhaustive and that the connection which I conceive between Adam and human events is intrinsic, indeed, but not necessarily independent of the free decrees of God, because the free decrees of God, taken as possible, and entering into the concept of a possible Adam, also become actual and are the cause of the actual Adam. I agree with you as against the Cartesians that possibilities are possible before all of God's actual decrees, but sometimes not without assuming these same actual decrees considered as possibilities. For the possibilities of individuals or of contingent truths include within their concepts the possibility of their causes, namely, the free decrees of God. It is in this that they differ from the possibilities of species or of eternal truths, which depend on God's understanding alone without involving his will, as I have already explained above.[383]

This may suffice. But, in order to make myself better understood, I will add that I think there is an infinity of possible ways in which to create the world, according to the different designs which God could form, and that each possible world depends on certain principal designs or purposes of God which are distinctive of it, that is, certain primary free decrees (conceived _sub ratione possibilitatis_) or certain _laws_ of the _general order_ of this possible universe with which they are in accord and whose concept they determine, as they do also the concepts of all the individual substances which must enter into this same universe. Everything belongs to an order, even miracles, though they may be contrary to certain subordinate maxims or laws of nature. Hence, assuming the choice of Adam as made, all human events must have happened as they have happened in fact, but not so much because of the individual concept of Adam, though this incloses them, as because of the designs of God which also enter into this individual concept of Adam and which determine the concept of the whole universe, and therefore the concept of Adam as well as those of all other individual substances in this universe. Each individual substance expresses the whole universe of which it is a part according to a certain relationship, through the connection which it has to all things by virtue of the coherence of the decisions or purposes of God.

I find that you raise still another objection, Sir, which is not concerned with consequences which seem to be contrary to freedom, as was the case in the objection which I have just answered, but with the thing itself, or with the idea which we have of an individual substance. For since I have the idea of an individual substance, namely, the idea of *myself*, you say:

> It seems to be in this that we must seek what should be said about the concept of an individual, and not in the way in which God conceives individuals. I need only to consult the specific concept of a sphere to conclude that the length of its diameter is not determined by its concept; in the same way (you say) I can discover clearly in this individual concept which I have of myself that I shall remain myself whether I make a journey which I have planned, or do not make it.[384]

To reply distinctly to this, I agree that the connection of events, though certain, is not necessary, and that I am free to make or not to make this journey. For although it is included in the concept of me that I shall make this journey, it is also included that I shall make it freely. And there is nothing whatever in me that can be conceived *sub ratione generalitatis seu essentiae seu notionis specificae sive incompletae*,[385] from which one can draw the conclusion that I shall make it necessarily. One can rather conclude from the fact that I am a man that I am able to think and as a consequence that, if I do not make this journey, it will not conflict with any eternal or necessary truth. Yet, since it is certain that I shall make it, there must be some connection between me, who am the subject, and the execution of the journey, which is the predicate, *for in a true proposition the notion of the predicate is in the notion of the subject*. If I did not make the journey, there would therefore be a falsehood which would destroy my individual or complete concept, or what God conceives of me or did conceive of me before he resolved to create me. For, *under the principle of* possibility, this concept includes existences or truths of fact or the decrees of God upon which facts depend.

I agree also that, in order to judge the concept of an individual substance, it is well to consult the concept which I have of myself, just as we must consult the specific concept of a sphere to judge its properties. But there is a great difference between the two, for the concept of myself in particular and of every other individual substance is infinitely more inclusive and more difficult to grasp than is a specific concept such as that of a sphere, which is incomplete and does not include all the circumstances necessary practically to arrive at a particular sphere. To understand what this I is, it is not enough that I sense myself as a substance that thinks; I must also distinctly conceive that which distinguishes me from all other possible spirits.[386] But of this I have only a confused experience. Although it is easy, therefore, to judge that the length of its diameter is not included in the concept of a sphere in general, it is not so easy to judge with certainty—though it can be judged with enough probability—whether the voyage which I plan to make is included in the concept of me. Otherwise it would be as easy to be a prophet as to be a geometrician. Yet experience cannot show me the infinity of insensible things in my body of which the general consideration of the nature of body and of motion can convince me. So likewise, although experience cannot let me sense everything that is included in my individual concept, I can know, in general, through a general consideration of the individual concept, that everything which pertains to me is included in it.

Surely, since God can form and does in fact form this complete concept which includes enough to explain all the phenomena that come to me, such a concept is possible and is the true complete concept of what I call myself, in virtue of which all my predicates pertain to me as their subject. This could be proved just the same, then, without mentioning God,[387] except insofar as it is necessary to indicate my dependence. But a stronger expression is given to this truth by deriving the concept which we are examining from the divine knowledge as its source. I admit that there are many things in the divine wisdom which we cannot understand, but it seems to me that we do not need to penetrate into them in order to answer our question. If in the life of some person, moreover, or even in the universe as a whole, some event were to occur in a different way than it actually does, there would still be nothing to prevent us from saying that this would be another person or another possible universe which God has chosen. And it would in that case be truly another individual. There must thus also be a reason a priori, independent of my experience, which justifies us in saying truly that it is I who was in Paris and that it is also I and not someone else who am now in Germany and that consequently the concept of myself must combine or include these different conditions. Otherwise it could be said that this is not the same individual, even though it might seem to be.[388] Some philosophers, who have failed adequately to understand the nature of substances or of indivisible beings, or beings per se, have in fact thought that nothing remains truly the same. It is for this reason, among others, that I conclude that bodies would not be substances if there were only extension in them.

I believe, Sir, that I have now satisfied your difficulties regarding the principal proposition. But, since you also make some important comments on certain incidental expressions which I have used, I shall try to explain these as well. I said that the supposition from which all human events can be deduced is not the creation of some vague Adam but the creation of an Adam such that he is determined in all his circumstances and chosen from an infinity of possible Adams. To this you make two important remarks, one in opposition to a plurality of Adams, and the other in opposition to the reality of merely possible substances. On the first point, you say, with very good reason, that it is no more possible to conceive of several possible Adams, if Adam be taken as a singular nature, than it is to conceive of several "myselves." I agree. But when I speak of several Adams, I do not take Adam for a determined individual but for some person conceived *sub ratione generalitatis*, under circumstances which seem to us to determine Adam to be an individual but which do not truly do so sufficiently; as, for instance, when we mean by Adam the first man, whom God puts in a pleasure garden, which he leaves through sin, and from whose side God makes a woman. But all this does not sufficiently determine him, and so there might be several other disjunctively possible Adams, or several individuals whom these conditions fit. This is true no matter what finite number of predicates incapable of determining all the rest one takes. But that concept which determines a certain Adam must include, absolutely, all his predicates, and it is this complete concept which determines the rationem generalitatis ad individuum.[389] For the rest, so far removed am I from holding that a single individual is a plurality that I am even deeply convinced of the teaching of St. Thomas about intelligences but hold that it is valid generally, namely, that there cannot be two individuals entirely similar or differing only in number.[390]

As for the reality of "purely possible substances," or "those which God will never create," you say, Sir, that you are "strongly inclined to believe that they are chimeras," an opinion to which I am not opposed, if, as I think, you mean that they have no other reality than that which they have in the divine understanding and the active power of God. Yet you see by this, Sir, that, in order to explain them satisfactorily, we are forced to have recourse to the divine knowledge and power. Your next observation I also find sound: that we never conceive of any purely possible substance except in terms of "some one"—or in terms of the ideas included in "some one"—of those which God has created.

> We imagine (you add) that before God created the world he envisaged an infinity of possible things, from which he chose some and rejected others; several possible Adams, or first men, each accompanied by a great train of persons with whom he is intrinsically connected. And we assume that the connection of all these other things with one of these possible Adams (or first men) is exactly like that which relates the created Adam with his whole posterity. So we are led to believe that God has chosen this particular one out of all the possible Adams, and that he did not will any of the rest.

In this you seem to recognize that these thoughts, which I admit are mine, provided the plurality of Adams and their possibility be understood in the sense which I have explained and provided that this is all regarded in terms of the way I conceive of a definite order in the thoughts and acts which I ascribe to God—you seem, I say, to recognize that they occur quite naturally to the mind when we think a little about the matter and even that they cannot be avoided. Perhaps they have displeased you only because you assumed that the intrinsic connection between these concepts cannot be reconciled with the free decrees of God. Everything that is actual can be conceived as possible, and, if the actual Adam will have a certain posterity in the course of time, one cannot deny this same predicate to this Adam thought of as possible, especially since you agree that God envisages in him all his attributes when he decides to create him. So these attributes pertain to him, and I do not see that what you say about the reality of possibilities is contrary to this. In order to call something possible, it is enough merely to be able to form a concept of it when it is only in the divine understanding, which is, so to speak, the realm of possible realities. As concerns possibles, I am thus content that one can form true propositions from them; thus one can judge, for example, that a perfect square implies no contradiction, even if there has never been a perfect square in the world. If we wished absolutely to reject such pure possibles, we should destroy contingency and freedom, for if nothing is possible except what God has actually created, whatever God has created would be necessary, and, in willing to create something, God could create only that thing alone, without any freedom of choice.

This leads me to hope that after the explanations I have given, to which I have always attached reasons in order to convince you that they are not subterfuges contrived to evade your objections, your thoughts will in the end be found to be not so far removed from mine as at first they seemed. You approve the interconnection of God's decisions; you accept as certain my principal proposition in the sense in which I explained it in my reply; you still question only whether I made this interconnection independent of the free decrees of God, and this quite rightly has given you difficulty. But I have shown that in my opinion it does depend upon his decrees and that, though it is intrinsic, it is not necessary.[391] You have insisted upon the difficulty there would be in saying that, if I do not take the journey which I should take, I am no longer myself, and I have explained the sense in which this can be said or not. Finally, I have given a decisive reason, which I believe has the force of a demonstration. It is that always, in every true affirmative proposition, whether necessary or contingent, universal or particular, the notion of the predicate is in some way included in that of the subject. Praedicatum inest subjecto; otherwise I do not know what truth is.

Now I do not demand any further connection here than what is really found [a parte rei] between the terms of a true proposition, and it is only in this sense that I say that the concept of an individual substance includes all its events and all its denominations, even those which are commonly called extrinsic,[392] that is, those which pertain to it only by virtue of the general connection of things and from the fact that it expresses the whole universe in its own way. For there must always be some foundation for the connection between the terms of a proposition, and this must be found in their concepts. This is my great principle, with which I believe all philosophers should agree, and one of whose corollaries is the commonly held axiom that nothing happens without a reason, which can always be given, why the thing has happened as it did rather than in another way, even though this reason often inclines without necessitating. A perfect indifference is a deceptive or incomplete assumption. It will be seen that I draw surprising conclusions from this stated principle, but this is only because we have not customarily carried our clearest knowledge far enough.

The proposition which has occasioned this discussion is, I may add, very important and deserves to be firmly established, for it follows from it that every individual substance expresses the entire universe in its own way and in a certain relationship, or from that point of view, so to speak, from which it regards it. It follows also that its subsequent state is the result, though free or contingent, of its preceding state, as if there were only God and itself in the world. Thus each individual substance or complete being is as a world apart, independent of every other thing but God. There is no stronger demonstration, not only that our soul is indestructible, but also that it preserves always within its nature the traces of all its preceding conditions with a virtual memory which can always be awakened because the soul has consciousness of, or knows within itself, that which each one calls "myself." It is this that makes it capable of moral qualities and of punishment and reward, even after this life. For without memory immortality would be worthless. Yet this independence does not prevent the intercourse of substances with each other, for, since all created substances are a continual production of the same sovereign being, by the same designs, and expressing the same universe or the same phenomena, they correspond exactly with each other. This leads us to say that one acts upon the other, because one expresses more distinctly than does the other the cause or reason of their changes. This is very much like our ascribing motion to a ship rather than to the whole sea, and with good reason, even though, speaking abstractly, another hypothesis about motion could be set up, since motion in itself, abstracted from its cause, is always something relative. It is thus, I believe, that the intercourse between created substances must be understood and not as a real physical influence or dependence; such an influence can never be conceived distinctly. It is for this reason that some thinkers have been compelled to admit that, as concerns the union of soul and body, or the action and passion of a spirit in relation to some other created being, their immediate interaction is inconceivable. Yet the hypothesis of occasional causes will not satisfy a philosopher, it seems to me, because it introduces a kind of continuous miracle, as if God were at every moment changing the laws of bodies on the occasion of the spirits' thoughts or were changing the regular course of the thoughts of spirits by arousing other thoughts in them on the occasion of bodily motions; or, in general, as if God as a rule interfered in some other way than by preserving each substance in its course and in the laws established for it. Thus only the *hypothesis of concomitance or of the correspondence of substances with each other* explains everything in a way that is understandable and worthy of God and is even demonstrative and in my opinion inevitable on the basis of the proposition which we have established. It seems to me also that it agrees better with the freedom of reasonable creatures than does the *hypothesis of impressions* or that of *occasional causes*. God created the soul in the first place in such a way that ordinarily it has no need of these alterations. Whatever happens to the soul arises out of its own depths without any need of its adapting itself to the body in successive events, any more than the body needs to adapt itself to the soul. Each following its own laws, the one acting freely, the other without any choice, each agrees with the other in the same phenomena. Yet the soul never ceases being the form of its body, because it expresses the phenomena of all other bodies following its relation to its own.

It may be more surprising, perhaps, that I deny the action of one corporeal substance upon another, which nevertheless seems so clear. But, aside from the fact that others have already done so, we must keep in mind that such action is a play of the imagination rather than a distinct conception. If the body is a substance, and not a simple phenomenon like the rainbow, or a being united by accident or by aggregation, like a pile of stones, it cannot consist in being extended, and we must of necessity conceive of something which we may call its substantial form and which corresponds in some way to the soul. After having long held otherwise, I have finally been convinced of this, almost in spite of myself.[393] Yet however much I may support the Scholastics in this general and, so to speak, this metaphysical explanation of corporeal principles, I agree also as closely as anyone can with the corpuscular theory in the explanation of particular phenomena, for to introduce forms or qualities here is to explain nothing.[394] We must always explain nature mathematically and mechanically, provided we keep in mind that the principles themselves, or the laws of mechanics or of force, do not depend on mere mathematical extension but on certain metaphysical reasons.

After all this, I believe that the propositions contained in the summary which was sent to you, Sir, will now seem not only more understandable but perhaps also more sound and more important than could have been thought at first.

II

[G., II, 111-29]

October 9, 1687[395]

Since I shall always place great weight upon your judgment when you can be brought to see the point at issue, I shall make an effort this time to make the positions which I consider to be important and all but certain seem at least tenable, if not certain, to you. For it does not seem to me difficult to reply to the doubts which you still have; these come, in my opinion, only from the fact that, however able a person may be, if he has preconceptions and his mind is distracted by other matters, he finds it very difficult at first to enter into a new line of thought, especially of a kind where figures, models, and sense perception are of no help.

I have said that the soul, which naturally expresses the entire universe in a certain sense and according to the relationship which other bodies have to its own, and which as a consequence expresses more immediately the properties of the parts of its body, must therefore, by virtue of the laws of relationship which are essential to it, particularly express certain unusual motions of the parts of its body. This happens when it feels pain. To this you reply that you have no clear idea of what I mean by the word express. If I understand by it a thought, you do not agree that the soul has more thought and more knowledge of the motion of the lymph in the lymphatic ducts than it has of the satellites of Saturn. But if I mean something else (you say), you do not know what it is. Therefore (assuming that I cannot explain it distinctly) this term will in no way help us to understand how the soul can give itself a feeling of pain, since to do this it would already have to know (in your opinion) that I had been pricked, instead of which it arrives at this knowledge only through the pain which it felt.

In reply to this criticism, I shall explain the term which you judge to be obscure, and I shall apply it to the difficulty which you have raised. One thing expresses another, in my usage, when there is a constant and regular relation between what can be said about one and about the other. It is in this way that a projection in perspective expresses a geometric figure. Expression is common to all the forms and is a genus of which natural perception, animal feeling, and intellectual knowledge are species. In natural perception and feeling it suffices that what is divisible and material and is found dispersed among several beings should be expressed or represented in a single indivisible being or in a substance which is endowed with a true unity. The possibility of such[396] a representation of several things in one cannot be doubted, since our soul provides us with an example of it. But in the reasonable soul this representation is accompanied by consciousness, and it is then that it is called thought. Now this expression takes place everywhere, because every substance sympathizes with all the others and receives a proportional change corresponding to the slightest change which occurs in the whole world, although this change will be more or less noticeable as other bodies or their actions have more or less relationship with ours. With this I believe Descartes would himself have agreed, for he would undoubtedly grant that, because of the continuity and divisibility of all matter, the slightest movement exerts its effect upon near-by bodies, and so from body to body to infinity, but in diminishing proportion. So our body must be affected in some way by the changes of all the rest. Now to all the motions of our body there correspond certain perceptions or thoughts of our soul, more or less confused; thus the soul will also have some thought of all the motions of the universe, and in my opinion every other soul or substance will have some perception or expression of it. It is true that we do not perceive all the motions of our body distinctly, as, for example, that of the lymph. But to make use of an example which I have already used, I must have some perception of the motion of each individual wave on the shore, in order to be able to perceive what results from the whole, namely, the great noise which is heard near the sea. So we also sense some confused result of all the motions taking place within us, but, being accustomed to this internal motion, we do not perceive it clearly and with reflection except when there is an important change, as in the beginning of illnesses. It would be desirable for physicians to work at the task of making a more exact distinction among the kinds of confused feelings which we have of our body. Now, since we perceive other bodies only through the relation which they have to ours, I was right in saying that our soul expresses best what pertains to our own body. Also, we should not know the satellites of Saturn and Jupiter except as the result of a motion taking place in our eyes. In all this, I believe, a Cartesian would agree with me, except that I assume that there are surrounding us souls other than ours, to whom I ascribe an expression or perception inferior to thought, while the Cartesians, instead, deny that beasts feel and admit no substantial forms outside of man. But this does not affect the question which we are discussing at present, namely, the cause of pain. We are now concerned with knowing how the soul perceives the motions of its body, since we do not see any means of explaining through what channels the action of an extended mass is transmitted to an indivisible being. The common run of Cartesians admit that they cannot give a reason for this union; the authors of the hypothesis of occasional causes consider it a *nodus vindice dignus, cui Deus ex machina intervenire debeat*.[397] I myself explain it in a natural way. By the concept of substance or of a completed being in general, which implies that its present state is always a natural result of its preceding state, it follows that it is the nature of each individual substance, and consequently of each soul, to express the universe. It has been created from the beginning in such a way that by virtue of the laws of its own nature it must come to agree with all that takes place in bodies, and particularly in its own. So we need not be surprised at the fact that it is its nature to represent the prick to itself at the moment that this happens to its body. To complete my explanation of this matter, let there be:

The state of the body at moment *A*	The state of the soul at moment *A*
The state of the body at the following moment *B* (prick)	The state of the soul at the following moment *B* (pain)

Just as the state of the body at moment *B* follows the state of the body at moment *A*, so the state of the soul at *B* follows from the preceding state of the same soul at *A*, in accordance with the concept of substance in general. But the states of the soul are naturally and essentially expressions of the corresponding states of the world and particularly of the bodies which then belong to them. Since, therefore, the prick is a part of the state of the body at moment *B*, the representation or expression of this prick, which is pain, will also be a part of the state of the soul at moment *B*. For, as one movement follows another, one representation similarly follows another in a substance whose nature it is to be representative. So the soul must perceive the prick, since the laws of correspondence require that it should express more distinctly any more noticeable change in the parts of its body. It is true that the soul does not always perceive the causes of the prick and of its future pain distinctly, when these are still concealed in the representation of state *A*, as is the case when one is asleep or for some other reason does not see the pin approaching. But this is because the pin then makes too small an impression upon us, and, although we are already affected in some way by all the motions and their representations in our soul, and so have within us the representation or expression of the causes of the prick, and therefore the cause of the representation of this same prick, that is, the cause of the pain, we cannot untangle them from so many other thoughts and motions until they become noticeably strong. Our soul reflects only on more unusual phenomena which are singled out from the rest; it does not think distinctly of any when it thinks equally of all. After all this I cannot guess where one can still find the slightest shadow of difficulty, unless we are to deny that God can create substances so constituted from the beginning that by virtue of their own nature they thereafter agree with the phenomena of all the others. But there is no apparent ground whatever for denying this possibility. For we see that mathematicians represent the motions of the heavens in a mechanism, as when

> Jura poli rerumque fidem legesque deorum
> Cuncta Syracusius transtulit arte senex[398]

—a thing which we can do much better today than could Archimedes in his day. Why should not God, then, who infinitely surpasses the mathematicians, be able to create representative substances in the beginning in such a way that, by their own laws and following the natural change of their thoughts or representations, they express everything which must happen to every body? It seems to me that this is not only easy to conceive but also worthy of God and of the beauty of the universe and in some sense necessary. For all substances should be in mutual harmony and interrelation, and all should express within themselves the same universe and its universal cause, which is the will of their Creator, and the decrees or laws which he has set up that they may adjust themselves to each other in the best way possible. This mutual correspondence of different substances (which cannot act upon each other, speaking with metaphysical rigor, and which nevertheless agree as though they were acting upon each other) is also one of the strongest proofs of the existence of God or of a common cause which each effect must always express according to its point of view and its capacity. Otherwise the phenomena of different spirits would not at all accord with each other, and there would be as many systems as there are substances; or, better, it would be pure chance if they were sometimes to agree. The whole concept which we have of time and space is based on this agreement; but I should never finish if I had to explain everything exhaustively that is involved in our subject. Yet I should prefer to be lengthy rather than to fail in expressing myself adequately.

To go on to your other doubts, I think, Sir, that you will now see what I mean when I say that a corporeal substance gives itself its motion, or rather what is real in motion at each moment, namely, the derivative force from which motion follows. For every present[399] state of a substance is the result of its preceding state. It is true that a body which has no motion cannot impart motion to itself, but I hold that there is no such body.[400] You will say that God can reduce a body to the state of perfect rest, but I reply that God can also reduce it to nothing and that this body, deprived of action and passion, cannot in any sense comprise a substance. At least it suffices to say that if God should ever reduce any body to perfect rest, a thing which can happen only through a miracle, a new miracle would be needed to give it some motion. You will see, also, that my opinion confirms rather than destroys the proof of a prime mover. A reason must always be given for the beginning of motion, for its laws, and for the agreement of motions with each other, and this cannot be done without having recourse to God. Furthermore, my hand does not move because I will it, for I might well will a mountain to move, but unless I have a most miraculous faith it will not happen; my hand moves because I could not successfully will its motion except at the exact moment when the muscles of the hand make the contractions necessary to that end. All the more true is it that the passions of my soul agree with the motions of my body. The two always accompany each other by virtue of the correspondence which I have established above, but the immediate cause of each is within itself.

I come to the matter of the forms or souls, which I hold to be indivisible and indestructible. I am not the first to hold this opinion. Parmenides, of whom Plato speaks with veneration, as well as Melissus, maintained that there is only apparent generation and corruption, as Aristotle testifies in the De coelo, Book 3, chapter 2. And the author of the first book De diaeta, which is ascribed to Hippocrates, says explicitly that an animal cannot be engendered entirely anew or entirely destroyed. Albertus Magnus and John Bacon seem to have believed that substantial forms already lie concealed in matter from eternity; Fernel has them descend from heaven; not to mention those who take them from the world soul. These men have all seen a part of the truth but have not developed it.[401] Many of them believed in transmigration, others in the traduction[402] of souls, instead of noticing the transmigration that also transforms an animal already formed. Others, unable to explain the origin of forms in any other way, agreed that they originate by a true creation. And whereas I admit this creation in temporal succession only in the case of reasoning souls, and hold that all forms which do not think were created with the world itself, they believe, by contrast, that it takes place every day in the generation of the smallest worm. Philoponus, an ancient interpreter of Aristotle, in his book against Proclus, and Gabriel Biel seem to have been of this opinion. St. Thomas seems to me to consider the soul of beasts to be indivisible. Our Cartesians go even further, for they maintain that every true soul and substantial form must be indestructible and without generation. This is why they deny souls to beasts, although Descartes says in a letter to Henry More[403] that he cannot be sure that they have none. Since no offense is taken at those who introduce atoms which subsist permanently, why should it be found strange when the same thing is said about souls, to which indivisibility belongs by their very nature, especially since this becomes necessary when we combine the Cartesian conception of substance and the soul with that which everyone holds about the soul of beasts? It will be difficult to rid mankind of this opinion which has been held always and everywhere and which is universal if any opinion deserves that term, namely, that beasts have feelings. Now, assuming that it is true, my view about these souls is not only necessary on Cartesian principles; it is also important for morality and religion, in order to destroy a dangerous opinion to which many intelligent persons are inclined and which the Italian philosophers who follow Averroes have spread abroad, namely, that particular souls return to the world soul when animals die. This is in conflict with my demonstrations of the nature of individual substance and cannot be conceived of distinctly, since every individual substance must forever subsist separately, once it has begun to exist. This is why the truths I advance are very important. All who recognize that beasts have souls should approve them, while others ought at least not to find them strange.

Now to come to your doubts about this indestructibility.

1. I maintained that we must acknowledge something in bodies which is a truly single being, since the matter or extended mass itself can never be other than many beings [plura entia], as St. Augustine, following Plato, very well observed. Now I infer that, where there is not even one thing that is a true being, there cannot be many beings and that every multitude presupposes a unity. To this you make various answers, but without touching the argument itself. This you do not threaten, since you use only ad hominem arguments and point out weaknesses, trying to show that what I say is inadequate to meet the difficulty. First of all, you are surprised that I can make use of a reason which would be appropriate for Mr. Cordemoi, who explains everything by atoms, but which must necessarily be false for my position (as you judge it), since leaving aside animated bodies, which make up less than the hundred-millionth part of the rest, all other beings must necessarily be plura entia, so that the difficulty returns. But I see from this, Sir, that I have not explained myself well enough for you to understand my hypothesis. For aside from the fact that I do not remember having said that there is no substantial form outside of souls, I am far from holding the opinion that animated bodies are only a

very small part of the rest. For I believe rather that everything is filled with animated bodies. And in my opinion there are incomparably more souls than there are atoms according to Mr. Cordemoi,[404] who makes their number finite, while I hold the number of souls, or at least of forms, to be infinite. And, since matter is infinitely divisible, no portion can be designated so small that it does not contain animated bodies, or at least bodies endowed with a primitive entelechy or, if you permit me to use the concept of life so generally, with a vital principle; in short, corporeal substances, of all of which one can say in general that they are living.

2. As for the other difficulty which you made, Sir, namely, that the soul joined to matter is not truly one being, since matter is not truly one in itself and the soul gives it, as you think, only an extrinsic denomination; I reply that it is the animated substance to which this matter belongs which is truly a being and that matter, taken for the mass in itself, is only a phenomenon or a well-founded appearance, as are space and time also. It does not even have the exact and fixed qualities which could make it pass for a determined being, as I have already implied in my last letter, because in nature even the figure which is the essence of an extended and bounded mass is never exact or rigorously fixed on account of the actual division of the parts of matter to the infinite. There is never a globe without irregularities, or a straight line without intermingled curves, or a curve of a definite completed nature without being mixed with some other, and this in its small parts as in its large; so that, far from being constitutive of the body, figure is not even an entirely real and determinate quality outside of thought. One can never assign a definite and precise surface to any body, as could be done if there were atoms.[405] I can say the same thing about magnitude and motion, namely, that these qualities or predicates are of the nature of phenomena, like colors and sounds, and, though they involve more distinct knowledge, they can no more sustain a final analysis. As a consequence, extended mass considered without entelechies and consisting only in these qualities is not the

corporeal substance but a mere phenomenon like the rainbow. Philosophers have also recognized that it is the form that gives determinate being to matter, and those who have not taken this into consideration will never escape from the labyrinth of the composition of the continuum once they enter it. It is only indivisible substances and their different states which are absolutely real. Parmenides, Plato, and other ancient thinkers have rightly seen this. For the rest, I agree that the name one can be given to an aggregate of inanimate bodies even if no form unites them; thus I can say, "This is one rainbow or one herd." But this is merely a phenomenal unity or a unity in thought, which is insufficient for the reality within the phenomena.[406]

3. You object that I ascribe substantial forms only to animate bodies—a view, however, which I do not remember having taken.[407] But, since all organized bodies are plura entia (you continue), it follows that the forms or souls, far from making them one being, rather require several beings in order that the body can be animated. I reply that, assuming there is a soul or entelechy in beasts or in other corporeal substances, we must reason in this matter just as we all reason in regard to man. Man is a being endowed with a true unity given him by his soul, in spite of the fact that the mass of his body is divided into organs, ducts, humors, and spirits and that these parts are undoubtedly filled with an infinity of other corporeal substances endowed with their own entelechies. Since this third objection substantially merges with the preceding one, the solution given there will also apply here.

4. You conclude that there is no basis for giving a soul to beasts and that, if they had one, it would have to be a spirit, that is, a substance which thinks, since we know only bodies and spirits and have no idea whatever of any other substance; but that it is difficult to believe that an oyster thinks or a worm thinks. This objection applies equally to all who are not Cartesians. But aside from the fact that we must believe that what the whole human race has always held to be true about the feeling of beasts cannot be entirely

without reason, I believe that I have shown that every substance is indivisible and that therefore every corporeal substance must have a soul or at least an entelechy which is analogous to the soul, since otherwise bodies would be only phenomena.

To hold that every substance which is indivisible—this would, in my opinion, be every substance in general—is a spirit and must think seems to me incomparably more rash and unfounded than is the conservation of forms. We know only five senses and a limited number of metals; must we conclude that there are no others in the world? It is far more probable that nature, which loves variety, has produced forms other than those which think. If I can prove that there are no other figures of the second degree than the conic sections, this is because I have a distinct idea of these lines which gives me a method for arriving at their exact classification. But since we have no distinct idea of thought, and cannot demonstrate that the concept of an indivisible substance is the same as that of a substance which thinks, we have no basis for this assertion. I agree that the idea which we have of thought is clear, but not everything that is clear is also distinct. We know thought only through an internal sense, as Father Malebranche has already remarked.[408] But through sense we can know only the things we have experienced, and, since we have not experienced the functions of other forms, we need not be surprised that we have no clear idea of them, for we could not have one even if we were agreed that there are such forms. It is wrong to try to use confused ideas, no matter how clear they may be, to prove that something is impossible. And when I consider only distinct ideas, it seems to me conceivable that divisible phenomena or a plurality of beings can be expressed or represented in a single indivisible being; and this is sufficient for the concept of a perception, without the necessity of adding thought or reflection to this representation. I should like to be able to explain the differences or degrees of the other immaterial expressions which are without thought, in order to distinguish corporeal or living substances from the animals so far as they can be distinguished. But

I have not yet meditated enough about this and have not sufficiently observed nature to be able to distinguish the forms by the comparison of their organs and activities. On the basis of very important analogies in anatomy, Mr. Malpighi is strongly inclined to believe that plants can be included in the same genus with animals and that they are imperfect animals.[409]

5. It now remains for me merely to reply to the difficulties which you allege against the indestructibility of substantial forms. First of all, I am surprised that you find this strange and untenable, because, according to your own opinions, everyone who ascribes a soul and feeling to beasts must maintain this indestructibility. These supposed difficulties are only prejudices of the imagination which may stop the popular mind but which can have no effect upon minds capable of meditation. I think, too, that it will be easy to satisfy you in regard to them. Those who conceive that there is as it were an infinity of small animals in the least drop of water, as Mr. Leeuwenhoek has shown, and who do not find it strange that matter should be filled everywhere with animated substances, will not find it any more strange that there is something animated even in ashes, so that fire can transform an animal and reduce it to small size, instead of destroying it entirely. What can be said of one caterpillar or silkworm can be said of a hundred or a thousand animals. It does not follow that we should see the silkworm arise again from the ashes, for perhaps this is not the order of nature. I know that several people have affirmed that the seminal powers remain in the ashes in such a way that plants can arise from them again, but I do not want to make use of any doubtful experiences. I am unable to determine whether these small organized bodies, which are inclosed by a kind of contraction in a greater body which has just been corrupted, stand entirely out of the line of generation, as seems to be true, or whether they can return to the stage in their time. These are the decrees of nature, about which men should acknowledge their ignorance.

6. It is only apparently and in terms of the imagination that

the difficulty is greater in the case of larger animals which are seen to arise only from the union of two sexes. This seems to be no less true of the smallest insects. I learned some time ago that Mr. Leeuwenhoek holds opinions very close to mine, in that he believes that even the largest animals arise through a kind of transformation. I do not venture either to approve or to reject the details of his opinion, but I hold this to be true in general, and Mr. Swammerdam, another great investigator and anatomist, gives enough evidence of also inclining toward it. The opinions of these men in such matters are worth as much as those of many other men. It is true that, so far as I have seen, they do not extend this opinion so far as to say that corruption and death itself is also a transformation in the case of living beings devoid of a reasonable soul, as I hold it to be. But I believe that, if they were informed about this opinion, they would not find it absurd, and there is nothing more natural than to think that whatever has no beginning will also never perish. When one recognizes that all generation is but the increase and development of an animal which is already formed, it is easy to be persuaded that corruption or death is nothing but the diminution and involution of an animal which does not cease to subsist and to remain alive and organized. It is not as easy, it is true, to make this credible by means of particular observations as is the case in generation, but the reason is obvious; it is because generation proceeds in a natural manner, little by little, so that we have leisure to observe it, but death is a sudden reverse by a leap [per saltum], a return all at once to parts which are too small for us, because death ordinarily occurs in too violent a way to permit us to observe the details of the retrogression. Nevertheless, sleep, which is an image of death; and ecstasy; and the envelopment of a silkworm in its cocoon, which can pass for death; the resuscitation of drowned flies by covering them with a certain dry powder (instead of which they would have died completely if left alone); the reviving of swallows which make their winter quarters in the reeds and are found without an appearance of life; and, finally, the experiences of men frozen to death, drowned, or strangled, who have been brought back to life, about which a man of discernment has recently written a book in German, giving examples from his own experience and urging people who are confronted with such cases to make greater efforts to revive them than is usually done and describing methods—all these things serve to confirm my opinion that these different states differ only in degree. If we do not have the means for bringing about resuscitation in other kinds of death, this is only because we do not know what must be done, or, knowing it, our hands, our instruments, and our other remedies are inadequate, especially when the dissolution proceeds at once to the very small parts. Therefore we must not stop with the common conceptions of death or life, since we have both analogies and, what is more, firm arguments which prove the contrary. For I believe I have shown sufficiently that there must be entelechies if there are corporeal substances and that, if we grant these entelechies or these souls, we must recognize that they are incapable of generation and destruction. It is incomparably more reasonable, accordingly, to conceive of transformations of animated bodies than to imagine the passage of souls from one body to another, an ancient conviction which apparently comes only from transformation poorly understood. To say that the souls of beasts remain without a body or that they remain hidden in an unorganized body—all this seems less natural. Whether the animal resulting from the contraction of the body of the ram which Abraham sacrificed in place of Isaac should be called a ram is a question of terms, somewhat like the question of whether a butterfly can be called a silkworm. Your difficulty with this ram reduced to ashes, Sir, arises only because I did not explain myself sufficiently. For you assume that there remains no organized body in the ashes, and this gives you a right to say that such an infinity of bodiless souls would be a monstrosity, while I assume that there is no soul in the natural order without an animated body and no animated body without organs. Neither ashes nor other masses seem to me incapable of containing organized bodies.

As for spirits, that is, substances which think and are capable of knowing God and discovering eternal truths, I hold that God governs them according to laws which differ from those by which he governs the other substances. For, while all the forms of substances express the whole universe, it can be said that the substances of beasts express the world rather than God, but that spirits express God rather than the world. Also, God governs the substances of beasts according to the material laws of force or of the transmission of motion. But he governs spirits according to the spiritual laws of justice, of which the others are incapable. It is for this reason that the substances of beasts can be called material, because the economy which God follows with respect to them is that of a worker or a mechanic; but with respect to spirits God fulfils the function of a prince or a legislator, which is infinitely higher. With regard to material substances God is only what he is in relation to everything—the universal Author of beings. He assumes another role with regard to spirits, in which we are led to conceive him as endowed with will and moral qualities, since he is himself a spirit, and, as one among us, he even enters with us into the relationship of a society, of which he is the head. And it is this society or universal republic of spirits under this sovereign monarch which is the noblest part of the universe, being composed of so many little gods under this supreme God. For one may say that created spirits differ from God only in degree, or as finite to infinite. It can truly be said that the whole universe was not made except to contribute to the ornament and happiness of this City of God. This is why everything is arranged in such a way that the laws of force or purely material laws work together everywhere to carry out the laws of justice or of love, so that nothing can harm the souls which are in the hand of God, and everything must work for the greatest good of those who love him. It is for this reason that spirits must preserve their personalities and their moral qualities, so that the City of God will lose no person; they must particularly preserve some kind of reminiscence or consciousness, or the power to know what they are, upon which all their morality, sufferings, and punishments depend. As a result they must be exempt from those upheavals of the universe which would make them entirely unknowable to themselves, so that, in the moral sense, they would be another person. For the substances of beasts, on the other hand, it is enough if they merely remain the same individual in a metaphysical sense, though they may be subject to all imaginable changes, since they are also without consciousness or reflection. As for the details of this state of the human soul after death, and the way in which it is exempt from the upheavals of the world, only revelation can instruct us in the particulars; the jurisdiction of reason does not reach so far. An objection will perhaps be made to my holding that God has given souls to all natural machines which are capable of them. Because souls do not interfere with each other and occupy no space, it is possible to give these machines souls in proportion to the perfection that they have, God doing everything in the most perfect way possible, and a vacuum of forms existing no more than a vacuum of bodies. One could say, then, that for the same reason God ought to give reasonable souls or souls capable of reflection to all living substances as well as to spirits. But I reply that laws superior to those of material nature, namely, the laws of justice, would oppose this. Since the order of the universe has not permitted justice to be observed in regard to all things, it had to be so arranged that at least no injustice should be done to them. This is why they were made incapable of reflection or consciousness and therefore not susceptible of happiness and unhappiness.

Finally, to summarize my thoughts in a few words, I hold that every substance contains, in its present state, all its past and future states and even expresses the whole universe according to its point of view, nothing being so remote from anything else that there is no intercourse between them. This is particularly so in its relation to the parts of its own body, which it expresses more immediately. Consequently, nothing happens to it except from its own depths and by virtue of its own laws, provided we join to it the concourse of

God. But every substance perceives other things because it expresses them naturally, having been created in the first place in such a way that it can do this thereafter and can adapt itself as it should. It is in this obligation imposed from the beginning that what is called the action of one substance on another consists. As for corporeal substances, I hold that, when we consider only that which is divisible, mass is a pure phenomenon; that every substance has in metaphysical rigor a true unity; that it is indivisible, incapable of generation and corruption; that all matter must be filled with animated, or at least living substances; that generation and corruption are nothing but transformations from small to great or the reverse; and that there is no particle of matter which does not contain a world of innumerable creatures, organized as well as massed together. Above all, I hold that the works of God are infinitely greater, more beautiful, more numerous, and better ordered than is commonly thought and that the mechanism or organization—in other words, the order—is essential to them even to their smallest parts. Thus no hypothesis can give us a better knowledge of the wisdom of God than can mine, according to which there are substances everywhere which show forth his perfection, being so many mirrors, all different, of the beauty of the universe, nothing remaining empty, barren, uncultivated, and without perception. We cannot even doubt that the laws of motion and of the revolutions of bodies serve the very laws of justice and of public order which are undoubtedly observed as well as possible in the government of spirits, that is, of intelligent souls which enter into society with God and with him constitute a kind of perfect City of which he is the monarch.

Now I believe, Sir, that I have omitted none of the difficulties which you have propounded or at least indicated or any which I thought you might have in addition. This has made my letter long, it is true, but it would have been more difficult to put the same meaning in fewer words, and could perhaps not have been done without obscurity. I believe now that you will find my beliefs consistent enough within themselves, as well as with accepted opinions.

I do not in any way repudiate established beliefs but explain them and push them further. If you could find leisure sometime to reexamine what we finally agreed upon as to the concept of an individual substance, you would perhaps find that, by granting me these beginnings, you are compelled to agree with all the rest. I have tried nevertheless to write this letter in such a way that it contains its own explanation and defense. The questions could still be separated, for those who are unwilling to recognize souls in beasts and substantial forms elsewhere could still give approval to my method of explaining the union of mind and body and all that I say about true substance. But they would have to save the reality of matter and of corporeal substances as well as they can without such forms and without anything which has a true unity, either by means of points or of atoms, as they find best. Or they might leave this undecided, for one can place limits on one's investigations wherever it seems fitting. But we must not linger along so beautiful a way if we desire true ideas of the universe and of the perfection of God's works, which still provide us with the soundest arguments with respect to God and our soul.

It is strange how entirely the Abbé Catelan missed my meaning, and you were right in suspecting this.[410] He advances three propositions and says that I find contradictions in them. But I do not; in fact, I have used these very propositions to prove the absurdity of the Cartesian principle. This is the result of dealing with people who consider matters only superficially. If this happens in a question of mathematics, what can we expect in metaphysics and ethics? This is why I consider myself fortunate in having found in you a critic who is as exact as he is just. I wish you many more years, for the public interest and for my own.

37

Letter of Mr. Leibniz on a General Principle Useful in Explaining the Laws of Nature through a Consideration of the Divine Wisdom; To Serve as a Reply to the Response of the Rev. Father Malebranche

Nouvelles de la république des lettres, July, 1687

This paper is Leibniz's second reply in a controversy begun by the Abbé Catelan in Bayle's journal, on the criticism of Descartes's physics in the "Brief Demonstration" (No. 34). In it Leibniz extends his criticism to Malebranche's laws of motion in Book VI of the Recherche de la vérité, charging that he as well as Descartes has violated the principle of continuity. The paper contains a clear statement of this principle and its importance in physical analysis. There exists also a Latin version (GM., VI, 129-35).

* * *

[G., III, 51-55]

I have seen in the Nouvelles de la république des lettres the reply of the Rev. Father Malebranche to the comment which I made on certain laws of nature which he had set up in the Recherche de la vérité.[411] He seems somewhat inclined to abandon these laws himself, and this frankness is most commendable. But he offers reasons and restrictions which would lead us back into the obscurity from which I have tried to free this subject and which violate a principle of general order which I have observed. I hope, therefore, that he will have the kindness to permit me to use this opportunity to explain this principle, which is of great value in reasoning and which I find is not used enough or sufficiently understood in its entire scope.

This principle has its origin in the infinite and is absolutely necessary in geometry, but it is effective in physics as well, because the sovereign wisdom, the source of all things, acts as a perfect geometrician, observing a harmony to which nothing can be added. This is why the principle serves me as a test or criterion by which to reveal the error of an ill-conceived opinion at once and from the outside, even before a penetrating internal examination is begun. It can be formulated as follows. When the difference between two instances in a given series or that which is presupposed can be diminished until it becomes smaller than any given quantity whatever, the corresponding difference in what is sought or in their results must of necessity also be diminished or become less than any given quantity whatever. Or, to put it more commonly, when two instances or data approach each other continuously, so that one at last passes over into the other, it is necessary for their consequences or results (or the unknown) to do so also. This depends on a more general principle: that, as the data are ordered, so the unknowns are ordered also. [Datis ordinatis etiam quaesita sunt ordinata.][412] But examples are needed in order to understand this. We know that a given ellipse approaches a parabola as much as is wished, so that the difference between ellipse and parabola becomes less than any given difference, when the second focus of the ellipse is withdrawn far enough from the first focus, for then the radii from that distant focus differ from parallel lines by an amount as small as can be desired. And, as a result, all the geometric theorems which are proved for the ellipse in general can be applied to the parabola by considering it as an ellipse one of whose foci is infinitely far removed from the other, or (to avoid the term "infinite") as a figure which differs from some ellipse by less than any given difference.

The same principle is found in physics. For example, rest can be considered as an infinitely small velocity or as an infinite slowness. Therefore whatever is true of velocity or slowness in general should be verifiable also of rest taken in this sense, so that the rule for resting bodies must be considered as a special case of the rule for motion. If this does not work, on the other hand, this will be a certain sign that the laws are wrongly formulated. Likewise equality can be considered as an infinitely small inequality, and inequality can be made to approach equality as closely as we wish.

It is through his neglect of this consideration, among other things, that Descartes, able man that he was, failed in more ways than one, in his proposed laws of nature. I shall not repeat here what I have said before about the other source of his errors, in taking the quantity of motion for the force. But his first and second rules, for example, do not agree with each other.[413] The second says that if two bodies B and C collide in a straight line and with equal velocities, but B is but the least amount greater than C, C will be reflected with its former velocity, but B will continue its motion. But, according to his first rule, if B and C are equal and collide in a straight line, both will be reflected and return at a velocity equal to that of their approach. This difference in the outcome in these two cases is unreasonable, however, for the inequality of the two bodies can be made as small as you wish, and the difference between the assumptions in the two cases, that is, the difference between such inequality and a perfect equality, becomes less than any given difference; therefore, according to our principle, the difference between the effects or consequences ought also to become less than any given difference. Yet, if the second rule were true as well as the first, the result would be the contrary, for, according to this second rule, any increase, however small, of the body B, formerly equal to C, will make the greatest difference in the effects, in that it will change an absolute regression into an absolute continuation of motion. And this is an enormous leap from one extreme to another, whereas the body B should be reflected only a little less in this case, and the body C a little more, than in the case of their equality, from which this one can hardly be distinguished.

There are many other inconsistencies like this which result from the Cartesian rules and which an attentive observer using our principle will easily detect. That which I have found in the rules of the Recherche de la vérité comes from the same source. The Rev. Father Malebranche admits in a way that there is some difficulty in them, but he continues to believe that, since the laws of motion depend on the good pleasure of God, God could therefore have established laws as irregular as these. But the good pleasure of God is ruled by his wisdom, and geometricians would be nearly as surprised to see irregularities of this kind occur in nature as to see a parabola to which the properties of an ellipse with an infinitely remote focus could not be applied. Nor do I believe that any example of such inconsistency can be met with in nature; the more one knows her, the more geometric one finds her. It is easy also to see from this that these irregularities do not properly arise from the cause to which Malebranche ascribes them, namely, the false hypothesis of the perfect hardness of bodies; I agree that this is not found in nature. For if we were to assume this hardness, conceiving of it as an infinitely prompt elasticity, nothing would follow here from this assumption which could not be adjusted perfectly to the true laws of nature that apply to elastic bodies in general, and we should never arrive at rules as invalid as those with which I have been finding fault.

It is true that in composite things a small change can sometimes bring about a great effect. So a small spark, for example, which falls into a large mass of gunpowder can demolish an entire city. But this is not contrary to our principle, for it can be explained by these same general principles. Nothing like this can happen in primary or simple things, however, for otherwise nature would not be the effect of infinite wisdom. By this we see, a little better than by what is commonly said about it, how the true physics should in fact be derived from the source of the divine perfections. It is God who is the ultimate reason of things, and the knowledge of God is no less the beginning of science than his essence and his will are the beginning of beings. The most reasonable philosophers agree with this, but few of them can use it to discover any truths of importance. Perhaps these little samples will arouse some of them to go much further. It sanctifies philosophy to make its streams arise from the fount of God's attributes. Far from excluding final causes and the consideration of a being who acts with wisdom, it is from these that everything must be derived in physics. It is this that Socrates has already said most admirably in Plato's Phaedo, in arguing against Anaxagoras and other philosophers who are too materialistic and who, having first recognized an intelligent principle beneath matter, make no use whatever of it when they come to philosophize about the universe and, instead of showing that this intelligence does everything for the best and is the reason for the world which it has found good to produce in conformity with its ends, try to explain everything solely by the concourse of crude particles, thus confusing conditions and instruments with the true cause. This, says Socrates, is like trying to explain the fact that I am sitting in prison awaiting the fatal cup and am not rather on my flight to the Boeotians or some other people, where we know I could have saved myself, by saying that I have bones, tendons, and muscles that could be flexed in such a way as necessary in order to sit down. Truly, he says, these bones and these muscles would not be here, nor would you see me in this posture, if my mind had not judged that it is more worthy for Socrates to submit to what the laws of his country command.

This passage of Plato deserves to be read as a whole, for it contains some very beautiful and very profound thoughts. However, I agree that the particular effects of nature can and ought to be explained mechanically, though without forgetting their admirable ends and uses, which providence has known how to contrive. But the general principles of physics and mechanics themselves depend upon the action of a sovereign intelligence and cannot be explained without taking it into consideration. It is in this way that we must reconcile piety and reason and that we can satisfy those good people who fear the results of the mechanistic or corpuscular philosophy,[414] as if it could alienate us from God and from immaterial substances, whereas in truth, with the necessary corrections and rightly understood, it ought rather to lead us to them.

NOTES

NOTES TO VOLUME I

Introduction: Leibniz as Philosopher

1. According to the Gregorian calendar, which was not yet in effect in Leipzig when he was born but which had long been used in Roman Catholic countries. His birthdate is therefore often given as ten days earlier, June 21.

2. The Latin motto is: "With every lost hour, a part of life perishes"; the German, "Deeds make men."

3. Leibniz's papers contain suggestions for improving the speed and comfort of travel; the notorious alchemist Johann Joachim Becher, inventor of the phlogiston theory, sought to discredit him by the charge that he proposed a coach which should travel from Hanover to Amsterdam in six hours. Leibniz also projected plans for improving the mails, bookkeeping, currency and exchange, statistics, and other tools of economic life.

4. This failure Leibniz traces back to the Council of Constance in 1414-18. For the Council of Trent he had so much respect that he used its decisions as definitive (with some private interpretations; cf. No. 28) for his own theological writing.

5. This term, so common in the literature of the seventeenth century, is based on the Stoic virtue of honestas, which we translate "honor" for want of a better word. The reader should be warned, however, that the translation, though appropriate for the seventeenth-century usage, does not fit the Stoic sense itself and that "honor" here is used to designate inward virtue and quality of character, not a reputation.

   To the feared revolution Leibniz alludes in his earliest writings, especially those against atheism, as well as in his later ones. See the New Essays, IV, 16, 4 (G., V, 444).

6. La Crise de la conscience européenne, 1680-1715 (Paris: Boivin, 1935).

7. Bedenken welcher Gestalt Securitas publica interna et externa und Status praesens jetzigen Umständen nach auf festen Fuss zu stellen (Klopp, I, 193-315).

8. As a basis for this reform Althus had proposed the logic of Peter Ramus.

9. In his Observations sur le projet d'une paix perpétuelle (of the Abbé de Saint Pierre) Leibniz, repeating the introduction to his Tractatus de jure suprematus (1677), outlines his plan for a confederation of Christian nations in Europe, united under a church and an international council or senate.

10. The proposed Elements of Natural Law were to open with a criticism of Hugo Grotius, to whom Leibniz owed his emphasis upon the law of nature but with whose efforts to find a basis for this law independent of religion he disagreed from the first.

11. The reader interested in the details and issues of the bitter dispute

about priority and plagiarism in the discovery of the calculus should consult C. B. Boyer, *The Concepts of the Calculus* (New York: Columbia University Press, 1939), pp. 187 ff.; M. Cantor, *Vorlesungen über Geschichte der Mathematik* (2d ed.), Vol. III, chap. lxxxix; J. M. Child, *The Early Mathematical Manuscripts of Leibniz* (Chicago, 1920); A. de Morgan, *Essays on the Life and Work of Newton* (Chicago, 1914); and J. E. Hofmann, *Leibniz' mathematische Studien in Paris* (Berlin: De Gruyter, 1948). It is now well established that Newton and Leibniz made their studies independently, beyond suggestions and efforts to solve the problem which both might have found in Barrow, Pascal, and a host of others. Hofmann in particular points out the responsibility which Leibniz had in making the charges possible, while De Morgan criticizes Newton and the Royal Society. The symbols and terms still used are Leibniz's.

12. Bertrand Russell has once more repeated his charge (*A History of Western Philosophy*, chap. xi), easily refuted by the facts, that Leibniz himself suppressed publication of his logical and metaphysical analyses out of a concern for personal advancement. Such an interpretation disregards the wide range of Leibniz's interests, his actual publication, and his efforts to prepare for and to secure publication. His problem was rather the lack of readers who grasped the more technical parts of his thought.

    A recent application of a mathematical discovery of Leibniz is the use of the binary number system in the construction of the large electronic computer at the Institute of Advanced Study, Princeton, under the direction of John von Neumann. It deserves comment that this numerical system, using only the numbers 1 and 0, was developed by Leibniz not only for its practical usefulness in computation but for its symbolic theological significance as "the image of creation," but it serves this modern project in a most utilitarian sense, saving about two-thirds of the tubes and components needed for the decimal system.

13. Louis Davillé, *Leibniz Historien* (Paris, 1909). See also W. Conze, *Leibniz als Historiker* (Berlin, 1951).

14. In a plan for his encyclopedia, drawn up in 1679, Leibniz includes in his classification of the sciences "Geopolitics, or concerning the state of our earth in relation to mankind, which includes all history and political geography" (Cout. OF., p. 40).

15. Cout. OF., pp. 5, 3-4. Pacidius was a pen name of Leibniz; Theophilus was frequently the exponent of his views in his dialogues. Cf. No. 23 and the *New Essays*.

16. A note on passive obedience is significant enough in relation to the political strains of the time to be reproduced. To the younger Baron von Boineburg he wrote in 1695:

    "As for the matter you further touch upon, Sir, the great question of the power of sovereigns and the obedience which their peoples owe them, I usually say that it would be good for the princes to be persuaded that their people have the right to resist them, and for the people, on the other hand, to be persuaded of passive obedience. However I am quite of the opinion of Grotius, that one ought regularly to obey, the evil of revolution being greater beyond comparison than the evils which cause it. Yet I recognize that a prince can go to such excess, and place the well-being of the state in such danger, that the obligation to endure ceases. This is most rare, however, and the theologian who authorizes violence under this pretext should take care against excess; excess being infinitely more dangerous than deficiency" (Guh. L., II, Anmerkungen, p. 30).

17. "It is in his limitation that the master reveals himself."

18. Leibniz describes his reading habits to Foucher in 1675 (No. 11).

19. In sending the Principles of Nature and of Grace to Remond (No. 66) —he had already given a copy to Prince Eugene of Savoy, the great personification of honnêteté—he wrote:

    "I have hoped that taken together with what I have published in the journals of Leipzig, Paris, and Holland, this little paper will contribute to the better understanding of my thoughts. In the Leipzig journal I have rather adapted myself to the language of the Schools, in the others more to the style of the Cartesians. In this last piece I try to express myself in a way that can be understood by those who are not accustomed to either of these styles."

20. A critical task should be done on the papers of Leibniz, which must be postponed until they have appeared in a critical edition. This might be called a form-critical analysis of his writings. For the purpose of understanding the present selection, the following classifications are important. (1) Classification according to language. For instance, Leibniz thought of the Latin translation of the Theodicy as one which should contain more scholarly and exact distinctions than the French original. (2) Classification according to style, which is effected both by periods in time and by the purpose of the work. Leibniz's early works are often flowery, suffuse, and overweighted with ornament; the progress toward the clarity of phrase and cadence in the Monadology (1714) is by no means continuous. To the courtly, scholarly, and popular styles should be added the exalted language of many religious writings, reflected not merely in the length and rhythm of the periods but in the handwriting itself. (3) Classification according to stage of completion. Though completion is largely an unachieved ideal for Leibniz, there are definite stages in the progress. First come scraps of notations and reading notes. The first drafts are usually written on the left half of each page, with the right half reserved for later revisions and additions, which are sometimes more extensive than the first draft itself. Several revisions may then be recopied, often by secretaries, before a copy is ready for circulation or publication.

21. Disregarding omissions in Bodemann's catalogues, the Hanover library contains over fifteen thousand letters, written in correspondence with 1,063 different persons.

22. It is true that Herrenhausen may never have had a labyrinth until the reconstruction of recent years, but a plan from the period of John Frederick shows one. Leibniz owes the use of the figure in philosophy to Libertus Fromond, Labyrinthus de compositione continui (1631). Fromond (1587-1653) was friend and editor of Jansen.

23. Leibniz was, however, inclined to interpret this principle in a nominalistic rather than a Scotist sense, his early dissertation De principio individui rejecting the Scotist principle of haecceitas in favor of the view that "every individual is individuated in its entire being" (G., IV, 18-19, 23-24). But in his later thought individuation occurs in the individual concept or law, and his position may therefore be considered a modern version of the Scotist one. See also n. 91 to the text.

24. "When God calculates and carries out his thoughts, the world is made" (No. 17).

25. The sources of this principle are in Aristotle's Analytica post., A, iv;

De inter., 17, a; *Cat.*, 1, a; etc. It was current in Leibniz's day, and *Arnauld* and Nicole used it as the test of axioms in the Port Royal Logic (*The Art of Thinking*, Part IV, chap. vi). A criticism of Leibniz's faulty extension of Aristotle's principle to substance is to be found in H. W. B. Joseph, *Lectures on the Philosophy of Leibniz*, pp. 85-87.

26. For Leibniz's use of this term see his correspondence with Des Bosses (No. 63).

27. "Whenever anything exercises its virtue or power, that is to say, when it acts, it improves and enlarges itself in proportion to its action" (No. 35, Sec. 15).

28. Leibniz seems not to have known the part played by Nicole in the authorship of the *Art de penser* until 1697, when Des Billettes told him of the collaboration of Arnauld and Nicole (G., VII, 457-58).

29. Leibniz frequently insists that we may use principles, like some of the geometric axioms of Euclid, with moral and practical certainty, without being able to demonstrate them from more general principles.

30. But Leibniz also recognized that, in particular truths of fact, this is true only "virtually" or implicitly, in the sense that subject and predicate can always be found to contain some simpler concept along with differentia which distinguish them. This is true of particular affirmative propositions. See, for example, No. 26.

31. On the general science see Cout. L., chap. vi, and H. Scholz, "Leibniz und die mathematische Grundlagenforschung," *Jahresbericht der deutschen Mathematiker Vereinigung*, LII (1942), 217-44.

32. See the works by Kabitz and Mahnke in the Bibliography.

33. See n. 25 above.

34. On the Scholastic doctrine of *suppositum* see n. 85 to the text.

35. The doctrine of the "middle knowledge" of God, devised by the Jesuit Luis Molina (*De liberi arbitrii concordia cum gratiae donis divina praescientia, praedestinatione, et reprobatione* [1588]) to solve the problem of human freedom and divine omniscience, was criticized by Leibniz in the *Theodicy*, Part I, Secs. 39-49. But he sometimes appropriated the term for his own theory of God's will as determining the optimum or the best possible (cf. No. 29; Cout. OF., pp. 22, 25-27, etc.).

36. The principle of the extremum or the optimum has had a long history since the classic debate between Maupertuis and König in the Prussian Academy in 1747. Mach ruled it out of physical considerations in his *Science of Mechanics* (5th ed.; Chicago, 1942), pp. 451-52, but in recent years it has reappeared as a principle of interpretation. W. R. Hamilton formulated it for classical mechanics in 1834; Helmholtz for electrodynamics in 1892; Hilbert related it to relativity theory in 1915 and 1917; and it has since appeared in most discussions of modern physical theory. Cf. Max Planck, *Physikalische Rundblicke* (Leipzig, 1922), pp. 103 ff.; Scholz, *op. cit.*, pp. 227 ff.; W. Dampier, *A History of Science and Its Relations with Philosophy and Religion* (New York, 1932), pp. 487-88.

37. Leibniz's example here is a striking anticipation of the illustration used by G. E. Moore in the modern debate on the internality of relations (*Philosophical Studies*, pp. 277, 290).

38. These two problems involved the essentials for the differential and the integral calculus, respectively. The integral sign first appeared in Leibniz's papers on October 29, 1675; the differential thirteen days later.

39. The historical beginnings of the mathematical study of probability are discussed in the correspondence with Bourguet and elsewhere (No. 69, letter of March 22, 1714). Leibniz was particularly interested in games as an expression of the free inventive spirit under regulated conditions and contributed an article to the first volume of papers of the Prussian Academy on the scientific study of games (*Miscellanea Berolinensia*, Part I, No. 3).

For a modern development and application of the theory of games in the spirit of Leibniz see Von Neumann and Morgenstern, *Theory of Games and Economic Behavior* (Princeton, N.J., 1944). The authors apply two Leibnizian principles: the combinatorial principle, with its functional assumptions, and the principle of the optimum.

40. See D. Mahnke, "Die Entstehung des Funktionsbegriffes," *Kantstudien*, XXXI (1926), 426-28. For a metaphysical use of the analogy from mathematics see the last note on Foucher's criticism of Des Gabets (No. 11, II); the second reply to Bayle, 1702 (No. 60); to Remond, February 11, 1715 (No. 68); etc.

41. Leibniz seems to have regarded Berkeley's subjectivism as paradoxical and a bid for attention, in his one mention of him in his correspondence (to Des Bosses; No. 61, letter of March 15, 1715). Malebranche's phenomenalism he criticized because of its denial of action to the physical world (No. 64).

42. Leibniz's physical analyses were completed at a time (1690-99) when he was particularly concerned to refute the error of occasionalists and pantheists in ascribing all power and action in nature to God alone (No. 53).

43. In No. 46, II, Leibniz uses the figure of a moving ship with its passengers completely inclosed, to illustrate his theory of the relativity of motion—the prototype of many more recent popular expositions of the special theory of relativity.

44. E. Rösler, "Leibniz und das Vinculum Substantiale," *Arch. f. Geschichte der Phil.*, XXIV (1913-14), 449-56.

45. See the monographs on the subject by M. Blondel and A. Boehm listed in the Bibliography.

46. Note the similarity to Kant's schematism of the pure concepts of the understanding, but with a realistic metaphysical reference instead of Kant's methodological one.

47. The term itself was used as early as Otto Casmann, *Psychologia anthropologica* (Hanau, 1594), but Leibniz used *pneumatica* or *elementa de mente* until around 1695. Like others, he had difficulty at first in spelling the new term (Cout. OF., p. 526; PA, IV, i, 288).

48. PA., VI, i, 53-57. This note, from 1663-64, is already important for

the mind-body problem; Leibniz recognized a matter and form within the soul itself, in addition to a matter and form in the body.

49. This theory of Leibniz does not appear until the New Essays. The term was Coste's translation of Locke's "uneasiness," which Leibniz appropriated. Compare Locke's Essay concerning Human Understanding, Part II, chap. xx, with the corresponding passage in the New Essays.

50. Leibniz's distinctive use of the term "apperception" seems also to have been suggested to him by the French reflexive form s'appercevoir used by Coste to translate "to perceive." The new use of the term first appears in the New Essays, Part II, chap. ix. The preface, in which it also occurs, was written later.

51. The belief encouraged by some histories of psychology, that the principles of association were first formulated in the well-known chapter in Locke's Essay (II, chap. xxxiii) is an error. See Leibniz's discussion in 1667 (No. 2), which was itself hardly original.

52. See the New Method of Teaching and Learning Jurisprudence, Part II, Sec. 15 (PA., VI, i, 301).

53. Cf. Otto Klemm, Geschichte der Psychologie (1911), pp. 177-78; F. Seifert, "Psychologie-Metaphysik der Seele," in Baeumler and Schröter, Handbuch der Philosophie, Vol. III.

54. Ilse Döhl, Bewusstseinsschichtung (Berlin, 1935).

55. Until around 1684 Leibniz remains uncertain in his terminology in this matter. He uses "perception" and "cognition" interchangeably for the fundamental act of knowing, until, about 1682, he shows a preference for the former term. Arnauld's use of the term in his controversy with Malebranche, which began with the True and False Ideas of 1683, must have strengthened Leibniz's decision to use it in the Discourse, intended for Arnauld. Likewise, he had been using "represent" and "representative" in the mathematical and symbolic sense for some time but did not apply it to the knowledge relationship itself, as did both Malebranche and Arnauld in their controversy, until the correspondence with Arnauld in 1686 (No. 36, I).

56. To Rudolf Christian Wagner, Leibniz admits that he uses the term "soul" in a broad and a narrow sense: broadly as the principle of action or form in all monads, narrowly for living forms only (June 4, 1710; G., VII, 529).

57. To Bierling, August 12, 1711 (G., VII, 501-2). Leibniz seems not to have called God the monas monadorum, however, though he frequently called him a person.

58. The New Essays concerning Human Understanding (cf. Book I, chap. ii) was probably completed as Leibniz left it by 1708, but it remained unpublished until 1765, when Raspe, the creator of the wonderful stories of Baron Münchhausen, published it in his edition of Leibniz's works. Leibniz's notes on Shaftesbury's Characteristics (No. 65), another Platonist who influenced the Romanticists, are illuminating in this connection.

59. The three principles, from Ulpian Institutes i. i. 3, are "To injure no one; to give to each his due; to live honorably."

60. See E. Cassirer, Leibniz's System, pp. 458-72, esp. pp. 469-70.

61. Metamorphoses 7. 21: "I see the better and approve it; I follow after the lower."

62. See Petzold's explanation, quoted by Mach, op. cit., pp. 471 ff.

63. A Critical Exposition of the Philosophy of Leibniz, chap. xv, pp. 172-90. Russell, in 1900, may have been influenced, like G. E. Moore, to accept Brentano's and Meinong's distinction between mental act and object.

64. An examination of Leibniz's examples of simple ideas shows that he means by them, sometimes, the irreducible elements in logical analysis, and sometimes the ultimate perfections of God or his attributes.

65. There is some ambiguity in Leibniz's use of the terms "nature" and "natural," as of their equivalent "physical." Most generally the natural is equivalent to the whole realm of creation or existence, which is subject to subordinate regulations, and therefore includes man and history. Sometimes, on the other hand, it applies only to corporeal nature or the realm of phenomena, exclusive of the internal life of monads and their striving for perfection.

No. 1. DISSERTATION ON THE ART OF COMBINATIONS

1. The term "hypothesis" is used here in its Platonic and mathematical sense, applying to the given principles upon which the demonstration is based. The term praecognitum appears in late Scholastic works in the context of ontology.

2. Leibniz's facile identification of the whole with a collective name, and the part with a particular subsumed under this name, is supplemented below (No. 1, III, 4) with a definition of the whole as a numerical relation between parts. Kabitz has shown that Leibniz's epistemology in this early period was nominalistic, sensationalistic, and naïvely realistic. His attitude toward nominalism is corrected in the introduction to the work of Nizolius (No. 6), but the distinction between names or symbols and the real order represented is developed later, as the theory of expression or representation becomes explicit.

3. For the next stage in Leibniz's cosmological argument for God's existence see No. 5, I; the mature formulation is in No. 51.

4. These theses were prepared for public disputation and first printed together with the definitions and first two problems. They are found in the footnote in G., IV, 41-43.

5. Leibniz has in mind the Arithmetic of Infinites of John Wallis rather than Seth Ward.

6. The theory that causality consists of an influxus physicus had been proposed by Francis Suárez (1548-1617) as a solution to the problem of efficient causality and had established itself through the wide use of his Disputationes metaphysicae (cf. Disp., XII, ii, 4).

7. Leibniz much later reports that as a boy of fifteen or younger he had walked in the Rosental near Leipzig, debating whether to accept the old philosophy of forms or the new atomism and mechanism and that

he had decided in favor of the latter (G., III, 205, 606). Kabitz has shown that his memory was in error here and that this decision could not have been made earlier than 1664 (K. Fischer, *Gottfried Wilhelm Leibniz* [5th ed.], p. 715). He is thus a mechanist at this point, convinced that a quantitative determination is possible of all qualities. But how much his thinking is still in the framework of Aristotelianism this and the following selections show.

8. Hugo Grotius, *On the Law of War and Peace* (Oxford, 1925), p. 25. The influence of Grotius was of decisive importance in the formation of Leibniz's legal thinking. Cf. n. 10 to the Introduction.

9. The letter to Thomas Hobbes (No. 4) contains another statement of this argument.

10. In providing a metaphysical basis for the category of number, Leibniz is already searching, following the tradition of Nicolas of Cusa, Galileo, and Descartes, for a mathematical science more general than arithmetic and geometry but including both and thinks of it in terms of the numbering of parts and their possible relationships. It was in the Paris period that he found that numbers are incapable of maximal determination and separated mathematics from metaphysics.

11. That is, algebra. Leibniz here overlooks the algebraic discoveries of Vieta, Cardan, and others. At this time he knew Descartes only by hearsay (cf. No. 3) and little mathematics beyond Euclid. Francis Schooten, professor at Leyden, edited the *Opera mathematica* of Francis Vieta in 1646 and also prepared an arrangement of Descartes's geometry which Erasmus Bartholinus published as the *Principia matheseos universalis seu introductio in geometriam Cartesii*.

12. "Disposition is the arrangement of that which has parts" (Aristotle *Metaphysics* 1027*b*).

13. Mathematics is thus in this period of Leibniz's thought an abstract consideration of metaphysical relations, particularly of those relational properties of substance upon which quantity rests. Leibniz's general mathematics and logic were always grounded in metaphysical principles.

14. Variations thus include, in modern terminology, both combinations and permutations, while situs is a permutation. When this permutation is in circular order (as in the case of the rearrangement in relation to each other of men seated about a table), it is vicinity; when relative position to the whole is involved, it is order.

15. That is, the number of permutations of four things taken four at a time is 24.

16. Complexions are in modern terminology combinations; the latter term Leibniz reserves for the special case of complexions of the second order. His example involves the total combinations of four things, with exponents from 1 to 4. Later he calls this "complexions taken simply" (Sec. 12).

17. Leibniz's source was Daniel Schwenter, *Deliciae physico-mathematicae* (Nürnberg, 1651-53).

18. Leibniz seems to have known a formula only for the combination of n things taken two at a time, namely, $C_2^n = n(n-1)$, and to have been ig-

norant of the more general form. He therefore chooses a tabular method suggestive of Pascal's triangle.

19. Note that the table involves a derivation of complexions by the additive use of 0 and 1 only and thus anticipates Leibniz's later interest in the binary number system.

20. Thus the total combinations of n terms = $2^n - 1$. We omit several sections dealing with special aspects of the rule for complexions.

21. Leibniz now offers twelve applications, most of which must be omitted because of length. For his thought about traditional logic the sixth, here omitted, is perhaps most significant. It contains his deduction of the valid modes and figures of the Aristotelian syllogism.

No. 2. A NEW METHOD FOR LEARNING AND TEACHING JURISPRUDENCE

22. Leibniz had mastered the terms and much of the literature of alchemy as a member of the Rosicrucian society in Nürnberg.

23. Jerome Rorarius (1485-1556) was best known for his *Quod animalia bruta saepe ratione utantur melius homine*. It was to the article on Rorarius in his *Dictionary* that Bayle later attached his criticism of Leibniz's philosophy (Nos. [illegible] and 60). Justus Lipsius (1547-1606) was a Flemish philologist and humanist; his *Epistolarum centuriae duae* was published in Leyden in 1591 and frequently republished.

24. Leibniz seems thus to accept witchcraft in 1667; later he commends the work of the Jesuit Friedrich Spee (*Cautio criminalis* [1631]) and of the Protestant pietist Philip Jacob Spener, with whom he began a correspondence while at Mainz, in opposing the widespread injustice of the witch processes (cf. *Theodicy*, I, Sec. 97).

25. "Drops hollow out a stone, the ring is worn by use,
And by its pressure the ground wears away the crooked plough share."
The German proverb: "The slow traveler gets there too."

26. Aristotle's doctrine of the common sense (*De anima* iii. i. 425) appears in Leibniz and other seventeenth-century thinkers as active perception. See n. 303.

27. Though Leibniz mentions Comenius only in the later revision notes of the *New Method*, the similarity of Sections 17-20 to the *Analytic Didactic*, Sections 128-60, is striking. It will be observed that Leibniz discusses frequency, intensity, recency, and emotional effect as factors in habituation many years before Locke's famous chapter on association. His interpretation of these factors is functional rather than conceptual, and he is careful to distinguish such learning through habituation from the use of intelligence. This corresponds to his later distinction between the empirical consecutions which men and animals have in common and reasoning of the kind which is restricted to man.

28. *De corpore*, Book i, chap. ii.

29. Leibniz frequently criticized the effort of Raymond Lully (1235-1315) to found an *Ars magna* in which all possible combinations of primitive

concepts were to be explored. John Henry Bisterfeld, professor at Leyden and follower of Comenius, was the source of many of Leibniz's early opinions on methodology, particularly of his conception of harmony and a method of discovery and judgment. Leibniz's notes on his works are printed in PA., II, i, 151-61.

30. Leibniz's reference to the Meditationes de prima philosophia is incorrect; the four rules appear in the Discours de la méthode, Part II.
Revision note of 1697-1700: ". . . Two rules: (1) that no derivative notion is to be accepted unless it is explained, and (2) no derivative proposition unless it is proved. Explanation takes place through definition, proof through the syllogism, which provides a conclusion by force of its form, even if it does not always make use of the Scholastic arrangement, and not everything necessary to the conclusion is expressed, in order to avoid tedium. But it is no small matter to have a way of reasoning infallibly on this basis if we do not avoid the effort involved. The rules of Descartes are less adequate, however. Certainly the first one—that what is perceived clearly and distinctly is true—is itself untrue (unless it be restricted on some ground), and proves, not existence, but only possibility. Nor is it very useful, unless we already have the criteria of clearness and distinctness which I once stated in a study on truth and ideas [No. 33]. This is not the place to explain which notions and truths are derivative, which primitive, and which it is sometimes useful to treat as primitive."

31. Sections 27 to 30 discuss bodily habits.

32. Revision note: "To will is nothing but the striving [conatus] arising from thought, or to strive for something which our thinking recognizes as good. Every thought is put in an enunciation or proposition or an affirmation or negation. For the use of even simple terms involves an affirmation of their possibility, and the act of reflection recognizes something active in ourselves."

33. The reader should be warned against the many meanings of imaginatio, which range from imagination through sense perception to intuition. In general, the term implies the activity of mind as opposed to sensation and is therefore more closely related to intellect than now. Cf. n. 108 and Vol. II, n. 241.

34. Leibniz's distinction between truths of fact and truths of reason, or contingent and necessary propositions, is not clearly developed until about 1679, when his logic has supplemented the strongly empirical emphasis in the present work.

35. Revision note: "So it can be said that the essence of a thing is its distinct conceivability (or imaginability) by us; its existence is its distinct perceptibility (or sensibility). For the composite of its qualities taken together constitutes the essence of a thing; its perceptibility proves its existence; that is, if a thing is not actually sensed, there is no thing."

36. Revision note: "From this grows metaphysics as a whole, to which the doctrine of quantity and quality in their widest sense can be referred, in logistics and the art of combinations, respectively. The former deals with propositions and their calculus (and hence with the one and the many, the whole and its parts), the latter with forms (or similarity and orders of determination). Logistics or the science of quantity makes use of infinite as well as finite magnitude. Determinate number belongs to arithmetic, indeterminate to algebra. I have begun

to build a science of the infinite through the invention of a new calculus; until now we have had only scattered bits of this."

37. Revision note: "Only two qualities are perceived in mind: *perceptivity* (or the power of perceiving) and *activity* (or the power of acting). *Perception* is the expression of many things in one, or in simple substance; if it is combined with the reflection of the percipient, it is called *thought*. We judge perception to apply not only to us but also to other living or organic beings, and thought to be not only in us but also (and, indeed, most perfectly) in God. This quality of the percipient is treated in *logic*, which, it happens, is at once a noble science in itself and serves other sciences as instrument by carrying the theorems of metaphysics into practice in investigating other truths."

38. Revision note: "*Activity* or *force* is perceivable in the mind alone; that is, the state of a thing from which change follows. We experience this intimately in ourselves, but also infer it in others from its effects. There is a double force—that of acting and that of resisting. The former is immaterial, the latter material, which resists action though it does not act unless impelled from without. Immaterial forces are the separate intelligences, as well as primary souls or entelechies in bodies. The simple, maximum exercise of force is conatus toward action."

    Notes 26 and 27 show how early Leibniz had formulated the psychological basis of his monadology. The shift from thought and causality to perception and force reflects the changes in his thinking in 1679 and the years immediately following.

39. Revision note: ". . . as the cause of change in us, which we can also say is in a certain sense the cause of the motion of the body, though it is difficult to explain how it acts. Perhaps, like others, we should attribute this power of acting externally, not to the influx of the mind into the body or to the reaction of the body, but to God, who affects the body at the bidding of the mind or, rather, who has, according to this opinion, so formed all things from the beginning that they respond to each other in time. Yet there remains the force of the action itself, insofar as the external changes follow the will of the soul in accordance with this divine institution. Conatus is itself of two kinds—that of a simple or of a composite thing. A simple thing is a percipient, and the conatus of the percipient as such is also called *appetite*, in a thinking being *will*. . . . In a composite being or a body, conatus is motive force; mechanics deals with this."

40. Revision note: ". . . extension and resistance. Number is perceived by all of the external senses, but because it is also perceived by the internal sense, and even more so, *arithmetic* is more rightly subordinated to metaphysics. Extension, which is perceived by sight and touch only, involves number, but adds *situation* to it, or the order of coexistence, and hence adds quality to quantity. Thus figures arise as modifications of extension; hence *geometry*."

41. It may be pointed out that in this empirical account of the structure of these categories Leibniz is not developing a theory of their ontological status. On the question of a vacuum, for instance, he is uncertain for a long time. See No. 3.

42. Sections 39-42 contain a chronological account of the educational process which begins with infancy and ends at the age of twenty. Leibniz prepared many more classifications of the sciences, particularly in his studies for the universal encyclopedia. The best-known discussion is in the *New Essays*, Book IV, chap. xxi.

No. 3. *Letter to Jacob Thomasius*

43. The double date at the head of many of Leibniz's letters is to be explained by the calendar reform then being carried out (cf. Introduction, n. 1). Following the report of his astronomers, Pope Gregory XIII had directed that ten days be dropped from the calendar. This was done at once in all Catholic countries, in 1600 in Scotland, in 1700 in the Protestant states of Germany (Leibniz himself helping to bring about the change), but not until 1752 in England. The earlier date is therefore "old style" (in use in Protestant countries in general, though not in Germany after 1700), the latter "new style," in Catholic countries. Leibniz was in this case in Catholic Mainz, Thomasius in Protestant Leipzig.

44. See n. 61, below.

45. Joseph Glanvill's *Plus ultra, or the Progress and Advancement of Knowledge since the Days of Aristotle*, appeared in 1668. Leibniz in 1679 adopted the title tentatively for his encyclopedia.

46. In his preceding letter Thomasius had mentioned a certain Baghemin of Stettin, who had asked the theological and philosophical faculties for a criticism of his new philosophy (G., I, 14).

47. The 1670 version reads: "Who would disagree with your judgment on the opinion that considers God as the primary matter of the world?"

48. In the 1670 version Spinoza is removed from the list of Cartesians, and Galileo added to and van Hoghelande removed from the non-Cartesians.

49. Leibniz uses the Greek title περὶ ψυσικῆς ἀκρόασεως.

50. Guericke's demonstration of the vacuum had taken place in 1654 and was well known, though Leibniz, in corresponding with him in 1671, was still urging publication of his discovery.

51. Leibniz's term is *massa*; thus Mach (*The Science of Mechanics* [5th ed.], p. 366) is in error in saying that he used this term only in 1695 and "probably borrowed it from Newton." His use is not, of course, Newtonian, though both men vary in their use of the term, sometimes regarding it as synonymous with matter, sometimes using it as a specific measure of a physical property. Note, however, that Leibniz uses it to mean extension and antitypy or impenetrability; he has not yet adopted Kepler's and Galileo's definition of mass as essentially inertia (cf. E. Hoppe, *Geschichte der Physik* [Munich, 1913], p. 61).

    The term ἀντιτυπία is a permanent favorite of Leibniz's. It was used for hardness by Plutarch and Sextus Empiricus.

52. *Metaphysics* 1068*b*; *Physics* 231*a*21*f*.

53. In a marginal note to the 1670 version Leibniz says, "Conring said the contrary." The letter to Conring, given in No. 18, alludes to this misunderstanding.

54. For Aristotle's analysis of motion see *Physics* viii and *Metaphysics* xii.

55. The figure of the city's perspectives is one of the most happy of Leibniz's figures; it is not usually recognized that the view from the tower represents an absolute essence. The distinction between the essence of a substance and its qualities, or between essence and modes, is

basic in Leibniz's logic and metaphysics, supporting his use of an intentional logic and his doctrine of substance.

56. Jean de Raey (d. 1702) had tried to synthesize Aristotle and Descartes in his Clavis philosophiae naturalis seu introductio ad naturae contemplationem Aristotelico-Cartesianam (1654). Thomasius had implied (G., I, 12) that Leibniz was influenced by him.

57. The works referred to are Julius Caesar Scaliger, Exotericarum exercitationum liber (1537) (a criticism of Cardan); Kenelm Digby (1603-65), Demonstratio immortalitatis animae rationalis (1664); Thomas White (or Albus, Anglus, Candidus) (1582-1676), Institutiones peripateticarum ad mentem summi clarissimique philosophi Kenelmi Equitis Digbaei (1646); Erhard Weigel (1625-99), Analysis Aristotelica Euclidea (1658) (Weigel had been Leibniz's teacher at Jena and influenced his mathematical ideas greatly); Abdias Trew (1597-1669), Directorium mathematicum (1657). On Scaliger see n. 98, below.

58. In Leibniz's mature thought substantial forms are active principles, but he frequently says that he returned to them after a mechanistic period in which he had abandoned them. And he does not, like the Scholastics, ascribe them to inorganic bodies. Insofar as he substantializes form (i.e., figure) in this letter, it amounts to an extension of the concept of substance to include geometric form; this is therefore a rejection of the Scholastic usage, but not like his later theory. See also No. 5, III, and n. 92.

59. The sentence thus far is omitted in G., I, 23, but restored in the 1670 version (G., IV, 170).

60. Reading esse for ese (G., I, 23).

61. The following fifteen lines in G., I, 23-24, were received by Thomasius himself in a corrupted form, as his marginal notations, according to Erd., indicate. They were omitted in the 1670 edition and are omitted here.

62. Following the version of 1670.

63. This sentence is omitted entirely from G., I, 25. Leibniz's criticism of active principles in inorganic nature, here directed at the Scholastic theory of substantial forms, as well as against Thomas Campanella (1568-1639), De sensu rerum et magia libros quattuor (1620), and Marcus Marci of Kronland (1595-1667), Philosophia vetus restituta (1662), is continued throughout his later writings. Campanella, Marcus Marci, and Scaliger all advocated creative ideas or powers of some kind in nature.

64. Reading vel (1670) for et (1669).

65. In the 1670 version Leibniz completes the paragraph from this point as follows: "I have argued this matter in an extemporaneous sketch which I put in the hands of Theophilus Spitzel. Though it did not deserve it, he sewed it, like a tattered patch on royal purple, to his recently published letter to Reiser on the eradication of atheism, with the title, A Confession of Nature against Atheists" (cf. No. 5, I).

66. Jean Bodin's Colloquium heptaplomeres de abditis rerum sublimium arcanis, a dialogue on religious tolerance, was not published until 1857. Leibniz's wish was thus almost fulfilled. His later judgment on

the work was more favorable (Guh. L., I, Notes, p. 14).

67. See No. 5, I. Philipp Jacob Spener (1635-1705) was one of the founders of pietism, a pastor in Frankfurt after 1666, where he founded the Collegia Pietatis in 1670. He was later famous as pastor of the Nicolaikirche in Berlin. Theophilus Gottlieb Spitzel (1639-91) was a Lutheran clergyman and scholar.

68. Leibniz's theory of "continuous creation" here seems merely to mean the source of all motion in God and is therefore very similar to the Cartesian opinion which he later criticized (cf. to De Volder, No. 55, I). A short paragraph alluding to obscure current events is omitted.

No. 4. Letter to Thomas Hobbes

69. This is the text copied by F. Tönnies from the original letter in the British Museum. The text in G., I, 82-85, is inaccurate.

70. Hobbes's discussion of the reaction of bodies in impact is in the *De corpore*, Book III, chap. xv, Sec. 2, though he does not, as Leibniz implies, explain cohesion by means of it.

71. We have retained the original term *conatus*, though Hobbes himself rendered it "endeavor." Like Hobbes, Leibniz at first identifies it with minimal motion; only much later, after his own distinction between force and motion, does it become "dead force."

72. See n. 52.

73. A short paragraph on the origin of springs is omitted.

74. The denial of sensation to the lower animals suggests a Cartesian influence; Leibniz soon drops it, however, for the view expressed in 1671 that there is a striving in all being but that its essential combination with memory or reflection becomes the distinguishing feature of mind as against matter (cf. No. 7, I, Sec. 17, and No. 10).

No. 5. Theological Writings Related to the CATHOLIC DEMONSTRATIONS

75. For the story of the project see the letter to Duke John Frederick of Hanover in 1679 (No. 28).

76. PA., VI, i, 499.

77. *Advancement of Learning*, Book I (Spedding and Heath, III, 267-68; cf. I, 436).

78. Horace *Ars poet*. 191: "And let no god intervene, unless a knot come worthy of such a deliverer" (Fairclough).

79. Leibniz follows Aristotle and the Scholastics in distinguishing always between body (corpus, corps) and matter, and the reader should not confuse the two concepts. Matter is never substance but is known only in abstraction from it. Here it is logically prior to corporeal substance; body is a determinate and bounded quantity of matter. Later, with the distinction between primary and secondary matter, matter is regarded as the passive, resisting aspect of monads and bodies.

80. This is not to be interpreted as an anticipation of Leibniz's later theory of unconscious perceptions, since the inner awareness, internal sense, or reflection of which he speaks is not a condition of consciousness itself. Cf. the discussion of reflection in the next selection. The argument which follows is an adaptation of Plato's old argument for immortality from the indivisible unity of the soul.

81. Part II, chapter iii, of the Catholic Demonstrations was to be a demonstration of immortality based on "the wonderful construction of dreams." This selection shows Leibniz's concern for "saving the phenomena" of mental life, as the preceding selection shows his concern also for physical phenomena.

82. "Speak! Why are you here?" "To call to one's mind."

83. "In this grave lie the bones of the venerable Bede."

84. The argument for immortality was obviously to rest upon this spontaneously active but unconscious principle in the mind. It points to the law of the individual, from which, in Leibniz's later thought, all the activities and properties of the mind flow.

85. For the late medieval doctrine of suppositum see E. A. Moody, Truth and Consequence in Medieval Logic (Amsterdam, 1953). The conception of suppositum, as individual subsistent substance, was established in Suárez, Disputationes metaphysicae, Disp. 34. That actiones sunt suppositorum is one of Leibniz's basic metaphysical principles, and the consistency of his pluralism and his logic depends upon his equation of this principle with the doctrine that in a true affirmative proposition predicatum subjecto inest. Cf. Introduction, Sec. v.

86. The doctrine of ideas stated in the remainder of this selection and in No. 6, II, is central in the development of Leibniz's metaphysics (cf. Loemker, "Leibniz's Doctrine of Ideas," Phil. Rev., LV [1946], 229-49).

87. Section 11 is missing in the manuscript.

88. Added note of Leibniz: "At this point it is to be proved, against Descartes, that space and extension really differ from body, because otherwise motion would not be a real thing, and a vacuum would be necessary."

89. Added note by Leibniz: "Ideas are unities of mind and body, as angles are unities of points and lines. Ideas are the same as the substantial forms of things. Thus ideas are in God as all action is in an agent, and as creation is in God. If it is asked whether an idea is created or not, I reply, is the created a creature or not?"

90. An imperfect section of the text, finding authority for the theory of ideas in Plato, Aristotle, Stoics, and Averroes, is omitted. It will be noted that in what follows Leibniz avoids the imputation of Averroeism by a distinction between mind and ideas.

91. Leibniz's departures from Thomism are significant; his view of individuality and of the soul is here Scotistic, though he had earlier rejected Scotus' principle of individuality. The unity of matter as an aggregate is never itself material but logical and mental. The soul itself, in turn, has its own matter, distinct from its body. Scotus seems also to have anticipated Leibniz's distinction between the bases of cer-

tainty in truths of reason and truths of fact, as well as his attempt to correct the ontological argument.

92. Cf. n. 58; this is already a different view of substantial form from that of the letter to Thomasius.

93. Added note by Leibniz: "Therefore it is not changed by the disposition of species to corruption."

94. Leibniz's note: "St. Thomas also thinks that the sacrament could have been celebrated at the time when the soul of Christ was separate. I do not know whether this is true. Perhaps, however, it could be understood separated from it in the same way that it is now separated from the host, namely, with suspended action."

95. In the Paris notes Leibniz rejects Spinoza's definition of mind as the idea of the body (No. 12). His attempted safeguards here against a monistic trend are later developed in the refutation of Spinoza, Malebranche, and Sturm.

No. 6. Preface to an Edition of Nizolius

96. *Anti-Barbarus, seu de veris principiis et vera ratione philosophandi contra pseudophilosophos* (Parma, 1553).

97. Aristotle *Eth. Nic.* i. i.

98. The most important work of the father, Julius Caesar Scaliger, Italian humanist (1484-1558), is his *Exotericarum exercitationum liber* in criticism of Cardan's *De subtilitate* (1557). The son, Joseph Justus Scaliger (1540-1609), reputed France's greatest philologist, is best known through the collections of anecdotes, the *Scaligeriana* (1666, 1669, etc.).

99. For many years Leibniz was concerned for the publication of the manuscripts of Joachim Jung (1587-1657), eminent scientist and atomist of Hamburg, whom he considered the equal of the most prominent scientists of other countries. His efforts failed, and the manuscripts were destroyed by fire in 1691. Leibniz purchased the library of Martin Vogel for the Duke of Hanover-Brunswick in 1678.

100. This brings to mind Schleiermacher's remark that Grotius and Leibniz could not have philosophized in German and Dutch, at least without being entirely different men. Cf. Guh. DS., II, 409-10. But Leibniz did succeed in using popular German effectively in explaining his opinions (cf. Nos. 40 and 48).

101. See n. 6, above.

102. The omitted section contains an account, first of critics of Aristotle, and then of recent interpretations and defenses of him in Italy, Germany, and England.

103. Hobbes's attempts to correct Euclid are indeed such as to arouse amazement, though his bad reputation as a geometrician rested primarily upon his twelve attempts at circle-squaring in the *De corpore* (chaps. xviii-xx) and the bitter dispute which followed, particularly with John Wallis. But his criticism of Cartesian geometry, his examination of geometric axioms, and his operational interpretation of ge-

ometric reasoning must early have proved suggestive to Leibniz. Cf. J. Laird, Hobbes (Oxford, 1934), pp. 37-38, 102 ff., 264-65.

No. 7. ELEMENTS OF NATURAL LAW

104. The title we use is that in PA.; Mollat, who first published the paper, gives the title as Elements of Law and Equity (Mitteilungen aus Leibnizens ungedruckten Schriften [Leipzig, 1893], pp. 19-36).

105. The allusion is to gunpowder; cf. Leibniz's epigram in verse on the bombs developed by the technicians of Louis XIV (Klopp, V, 636).

106. Cf. n. 104. Depending upon the context, we shall translate Jus either by Law (as opposed to laws), or Right (as distinct from rights).

107. Mollat appropriately documents this passage with Plato's Republic 507b. The influence of Plato's logic and ethics is apparent throughout the work.

108. Leibniz's theory of demonstration is stated more clearly and completely in Nos. 18 and 25. His view that principles of justice are truths of reason or of possibilities which condition but do not completely determine existence already presupposes the distinction between possibility and existence made in his later thought, though his logical theory still concerns only the former. What are here called clear and distinct intuitions (imaginationes) are the simple, primary concepts to which Leibniz believed all knowledge may be reduced by analysis and out of which all demonstration is therefore built.

109. See Livy vii. 6.

110. See Introduction, n. 5.

111. De finibus bonorum et malorum v; De officiis iii.

112. In the selection in n. 113, Leibniz extends this argument for the social multiplication of pleasure to God, making it a moral argument for creation and plurality. Here is implied also his argument for the necessity of evil as the source of variety in value. The mirror analogy was a favorite with Leibniz; it must be borne in mind that the mirrors of the seventeenth century were still imperfect reflectors, containing much materia prima or indistinctiveness and inertness, and that Leibniz may have had in mind concave focusing mirrors, of the kind he advocated for scientific uses and his friend Tschirnhaus was later to experiment with.

113. The following selection, from a somewhat earlier study in the Elements of Law, expounds another dimension of social harmony, namely praise, and also portrays its divine basis (PA., VI, i, 437-38 [from 1669 or 1670]):

"How few men there are who do not attribute some sense and a kind of reason to beasts, almost as to an infant who cannot be said to think. Yet they do not shrink from inflicting misery upon beasts for the sake of even the smallest benefit to themselves, and hardly anyone, in any age, with the exception of a few Pythagoreans, has charged that it is an injustice to kill beasts for the sake of our appetites, for the obvious reason that we are not afraid that they will plot against us.

"It is to be noted, however, that there is still another reason [i.e., besides fear of reprisal]. Concern for security is to be placed above concern for praise; one does not place acclaim higher than security. Hence tyrants care very little about being hated when they are safe, for they say, 'They may hate me, if only they fear me.' But even if we are beyond fear, we all seek praise. No wise man fails to desire praise, because he desires hamony. Praise is a kind of echo and duplication of harmony. If God had no rational creatures in the world, he would still have the same harmony, but alone and devoid of echo; he would still have the same beauty, but devoid of reflection and refraction or multiplication. Hence the wisdom of God demanded rational creatures in which things may multiply themselves. So one mind may be a kind of world in a mirror, as it were, or in a lens or some kind of point collecting visual rays. Therefore if we are prudent we try to give satisfaction to those whom we believe to be in a position to judge our actions as good and evil. Thus I hold that he is the most powerful or inviolable being of all who will seek as much of the highest good as possible."

Cf. also the following: "Harmony is diversity compensated by identity; or the harmonious is the uniformly difform" (PA., VI, i, 484 [from 1671]).

No. 8. *Studies in Physics and the Nature of Body*

114. The phrase is in J. E. Hofmann, *Die Entwicklungsgeschichte der Leibnizschen Mathematik während des Aufenthaltes in Paris* (Munich, 1949), p. 4. This work describes Leibniz's efforts to establish his reputation at this time and the unhappy effects upon his later relations with the Royal Society.

115. This section is preceded by definitions of the concepts involved in the laws of bodily impact. The title implies that Leibniz considers them as demonstrable, though they are treated as postulates. In his mature period such principles would be "subordinate maxims" (No. 35, Sec. 17) or principles of existence and therefore not completely reducible to the general laws of being by human minds. Here they illustrate Leibniz's a priori and synthetic approach to scientific laws, though the basic principles of being (except for the law of sufficient reason in Sec. 24) are not yet formulated.

116. Leibniz had read Léotaud's *Examen circuli quadraturae* and Cavalieri's *Geometria indivisibilibus continuorum nova quadam ratione promota* and is here struggling with the latter's indivisibles and the paradoxes involved in them. He makes no headway with the possible elements of a calculus of infinitesimals, however, until after he has read Pascal in Paris. His concern here is rather with the place of Hobbes's *conatus* as beginning of motion, in relation to geometric and phoronometric relations.

117. Cf. n. 71, above. Conatus is here an element of motion at a point; Leibniz does not distinguish force from motion until the period in which he criticized Descartes's theory of the conservation of quantity of motion (No. 34).

118. See n. 52.

119. The reflective perception of its own processes is thus the basis of memory and thought in the mind. Leibniz has here moved beyond the mind-body dualism of Descartes to a position in which both are analyzed into elementary motions endowed with feeling.

120. The difficulties which Hobbes's theory of the conatus creates with respect to the whole-part axiom of Euclid lead Leibniz eventually to distinguish between the relations of containing and inclusion, on the one hand, and part-whole, on the other. The Scholastic doctrine of signs, which he here introduces as elements wherein greater and smaller points or conatuses differ, is fruitful in the further development of Leibniz's thought, for it suggests the internal complexities of any particular value of $y = f(x)$, the *petites perceptions* in a present mental state, and the relations within a momentary impulse of force.

121. Contrary to Euclid's definition of a point as that which has no parts. The rest of this section contains applications to the geometry of angles, circles, regular polygons, and circular motion.

122. Thus Leibniz knew of the construction of the cycloid before studying Pascal, as well as the principle of compounding and resolving quantities of motion.

123. Phoronomy is the abstract theory of motion, or the interpretation of motion in terms of the general principle of the equivalence of preceding and succeeding states of motion. It thus adds to geometry the temporal dimension and lies midway between that science and Leibniz's later science of force, or dynamics.

124. See n. 55.

125. Leibniz uses *sentio* throughout this study for the fundamental mental act of apprehension; for the sake of clarity we have used, variously, "to see," "to perceive," and "to sense."

No. 9. *Letter to Magnus Wedderkopf*

126. The distinction between possibility and existence and the principle of the best possible were thus taking form in Leibniz's mind before he read Malebranche in Paris and before he criticized Spinoza's view that all possibles exist (No. 14, II, and No. 20). But there is no evidence that he has worked out the logical foundations of the distinction.

127. Later note by Leibniz: "I later corrected this, for it is one thing for sins to happen infallibly, another for them to happen necessarily." Whether Leibniz later succeeds in softening the harshness of his determinism is doubtful (see No. 29).

No. 10. *Letter to Antoine Arnauld*

128. That is, the ratio approaches zero. On Leibniz's use of the doctrine of signs see n. 120.

129. Reading *seu* for *sed* (as in No. 8, I, and following G.'s suggestion, p. 73).

130. *Determinatio* is generally the logical condition for a complete or existent notion, as opposed to incomplete or abstract notions. In his physical writings, however, Leibniz uses it in the sense of determined direction, as here interpreted.

No. 11. Letter to Simon Foucher

131. For an account of Leibniz's activities in Paris see L. Davillé, "Le Sejour de Leibniz à Paris," Archiv für Geschichte der Phil., XXXII (1920), 142 ff.; XXXIII (1920), 67 ff., 165 ff. This letter is in French, a new accomplishment of Leibniz. The date follows PA., rather than G., who surmises 1676.

132. The figure of Ariadne's thread, by which Theseus made his way out of the Cretan labyrinth, served Leibniz to illumine the purpose of his proposed universal characteristic and general science.

133. That is, metaphysics. The allusion is clearly to the Meditations on First Philosophy.

134. Giles Personne de Roberval (1602-75) was for over forty years the occupant of the famous chair established by Ramus at the Royal College.

135. Leibniz here puts the argument for an external world in its causal form, which will have to be modified after his later view of the self-determination of individual substances has been developed. But he always argues that the complex and coherent nature of our perceptions is the evidence for an external world.

136. The text of these notes is taken from F. Rabbe, L'Abbé Simon Foucher (Paris, 1867), Appendix, p. xlii. In his letter to Foucher, Leibniz has virtually admitted that human analysis cannot advance from truths of fact to the simple primary truths upon which they rest. These notes, on the other hand, show that he has not abandoned the realm of ideas and absolute truths as a foundation for all knowledge.

137. Leibniz's own view of ideas, to judge by his later definition in No. 21, includes both senses given here, if "form" is taken in a Platonic sense.

138. If this sentence is not a later revision note, it is an early appearance of Leibniz's conception both of the individual law or notion (cf. No. 35) and of primitive force.

No. 12. Selections from the Paris Notes

139. Cf. n. 126. The principle of the best possible is here given its mathematical scientific force as the principle of the maximum or extremum.

140. Conrad von dem Vorst, Protestant theologian banished from Holland in 1619 for his heterodoxy, published his Tractatus theologicus de Deo in 1610.

141. On Fromond see n. 22 to the Introduction.

142. Thus extension and thought are not simple attributes, as in Descartes and Spinoza. Yet Leibniz's theory of the immensum as the basis of extended beings, and active intellect as the basis of minds, as developed in these notes, carries signs of the influence of Spinoza as well as of Malebranche.

143. Characters are signs or symbols; they are here treated as physical but subjective and the basis of memory and thought.

144. It is significant that these notes were written soon after Leibniz had devised the symbols and operations of the calculus of differentials. The simple illustration of the different number sets emerging from 6 serves to illustrate his metaphysics of individual series, sharing some simple essences, but each a different functional expression of the underlying harmony of ideas in God.

No. 13. Letter to Henry Oldenburg

145. Walter von Tschirnhaus came to Paris with Oldenburg's recommendation and worked with Leibniz during the winter in which his discoveries of the calculus were made. It was he who brought Leibniz his first information about Spinoza's Ethics.

146. The term shows a transition from the Ars combinatoria of 1666 to the Ars characteristica of 1678 and the years following.

No. 14. Two Notations for Discussion with Spinoza

147. PA., II, i, 379. Leibniz also refers to his visit with Spinoza in the Theodicy, III, Sec. 376, and in later letters (G., VI, 339; PA., II, i, 535).

148. Leibniz's argument therefore rests on his identification of the simple concepts of his combinatorial logic with the perfections of God. Sense data are not simple but infinitely complex. That degrees of perfection and degrees of reality correspond is the common Neo-Platonic assumption of Leibniz and Spinoza. But the ontological argument fails when Leibniz admits that not all possible essences attain existence, so that, though God remains the seat of all perfections, existence is but the best possible of these. For the further development of this difficulty see Nos. 16, 20, and 31, I, ii.

149. The non is misplaced in G., VII, 261, with a distortion of the meaning.

150. Leibniz's original note ends here. What follows was added later.

151. This was the day after an interview with Spinoza. Cf. Couturat, "Sur la métaphysique de Leibniz," Revue de métaphysique et de morale, X (1902), 12.

152. Time is thus the principle of the existence of compossible events which would involve contradiction if regarded as eternal essences.

No. 15. ON A METHOD OF ARRIVING AT A TRUE ANALYSIS OF BODIES AND THE CAUSES OF NATURAL THINGS

153. Leibniz published "Le phosphore de M. Krafft, ou liqueur de terre seiche de sa composition qui jettent continuellement de grands éclats de lumière," in the Journal des savants, August 2, 1677. Not only Krafft but the original discoverer, Brand, visited Hanover to promote the manufacture of phosphorus. See also Leibniz's letter to Huygens, 1679 (No. 27, I). Fontenelle considered Leibniz's description of phosphorus, in his eulogy at John Frederick's death in 1679, as one of the finest productions of modern Latin poetry.

154. The terminology and the method of applying the theory of combinations are still those of the De arte combinàtoria (1666).

155. On the nature of distinct knowledge see No. 33, below.

156. The last sentence is a later notation in Leibniz's handwriting (the text is in the copy of a secretary, with some corrections by Leibniz). His account of the role of material analysis in technology may be compared with his later discussions of conceptual analysis in Nos. 18, 25, 32, and 69, II.

No. 16. Letter to Arnold Eckhard

157. The following comment of this kind, on a point omitted in the present letter, is regarded by Mahnke as the first explicit recognition by Leibniz of unconscious mental processes. "It is assumed here that there is nothing actually in our minds of which we are not conscious; this I seriously doubt" (G., I, 261, n. 92).

158. Reading studiose for sudiose (G., I, 266).

159. See n. 148, above.

160. In his notes Leibniz had said "by impressed species," that is, "from without" (G., I, 261). Note that Leibniz here still uses the language of interaction.

161. Note to Eckhard's letter: "Even if 'all things' is not inconsistent with 'to understand,' it is inconsistent with itself when combined with 'to understand.' Just so, 'to see' is not inconsistent with eyes, nor is 'to see everything' inconsistent with 'to see.' Yet 'to see everything' is inconsistent with eyes. So it must be demonstrated that it does not conflict with the nature of mind to understand everything" (G., I, 250).

162. This already points, not only to a pluralism of self-determining beings, but to the distinction between the two levels of being, that of possibilities determined by God's intellect and that of existence determined by God's will.

163. Note to Eckhard's letter: "I know that it is the opinion of Descartes that the truth of things depends on the divine will; this has always seemed absurd to me. For thus the necessity of the divine existence, and therefore of the divine will, itself depends on the divine will. Thus it will be a nature prior, yet posterior to itself. Besides, the principle of necessary truths is only this: that the contrary implies a contradiction in terms. . . . Since then the incompossibility of contradictories does not depend on the divine will, it follows that neither does truth depend on it. Who would say that A is not non-A because God has decreed it?" (G., I, 253).

No. 17. DIALOGUE

164. The discussion of truth and falsehood and their relation to thought and things in The Art of Thinking ("The Port Royal Logic") by Arnauld and Nicole is similar to this, and Leibniz may have been influenced by this source. See The Art of Thinking, Part II, chap. v, "On the Falsity To Be Found in Complex Terms and in Incident Propositions."

165. Leibniz's position here implies his opinions expressed in the letter to Foucher (No. 11), where he distinguished the purely formal logical necessity inherent in hypothetical truths when their relations to an external order are neglected from their material and hypothetical truth which depends upon the relation to a "suppositum."

166. Thomas Hobbes, De corpore, Book I, chaps. iii, vii-ix. Cf. the analogous position of Descartes concerning the divine will, criticized in n. 163, above.

167. Note on the margin of the manuscript: "When God calculates and exercises his thought, the world is made."

168. See n. 153, above.

No. 18. Letter to Herman Conring

169. It must be noted that analysis and synthesis cannot be correlated with deduction and induction, or the converse. Leibniz thinks of all ratiocination as deductive, the role of analysis or synthesis depending upon whether the simpler and more abstract, or the compound and more concrete concepts are known (cf. Introduction, Sec. IV).

170. In Leibniz's final copy this sentence was changed as follows: "We must take care, that is, not merely that the predicate is in the subject but also that subjects and predicates, not only in the same proposition but in all the propositions occurring in the same proof, are equally extended." The use of the principle that the predicate is in the subject begins in this period, but it is here clear that this principle is subordinate to the principle of identity. Though Leibniz, here regarding an algebraic solution as a special case of logical demonstration, already conceives of the equivalence of subject and predicate in a proposition, this is always in an essential and intensional sense rather than an extensional interpretation.

171. That is, mechanistic interpretations of nature in general, which Leibniz sometimes identifies as the corpuscular philosophy (see n. 394).

172. See No. 3 and n. 53.

173. Arnold Eckhard (see No. 16).

174. Leibniz did not, in fact, publish his findings on the quadrature of the circle until 1682, and then in the Leipzig Acta eruditorum; in the same journal he first published his findings on the differential calculus in 1684.

175. Conring's important study of the Empire, De finibus imperii Germanici Libri II (1654), appeared in a new edition in 1693.

No. 19. Letter to Walter von Tschirnhaus

176. On Tschirnhaus see the letter to Oldenburg (No. 13) and n. 145.

177. Leibniz later wrote at the head of this letter, "To Mr. Tschirnhaus at Rome, end of May, 1678. Tschirnhaus received the letter, for he answered it and repeated my words in his reply. In it I already explained to Tschirnhaus my general method for investigating quadratures; also the mark of a real definition, which is possibility. He later attributed both to himself." It was Tschirnhaus' publication of

some of these results that caused Leibniz to publish his methods in the differential calculus in 1684.

178. The logical calculus (Nos. 26 and 41) is thus only an application of the universal characteristic, other phases being algebra, cryptography, the geometry of situation, the universal language, etc.

179. Both correspondents had been trying to find the roots of higher algebraic equations by applying their combinations to the coefficients of the terms of the equation.

180. See No. 27 and the criticism of Euclid contained in it.

181. In June, 1682, Leibniz said that Tschirnhaus was now freed "from some prejudices drawn from Descartes and Spinoza, against which I once preached on various occasions, since I have always held that neither thought nor extension are primitive or perfectly understood terms" (PA., II, i, 528). But Tschirnhaus' Medicina mentis (1687), in which he proposes a mathematical logic as the medicine of the mind, was influenced by Spinoza's De emendatione intellectus as well as by Leibniz.

A more positive judgment on Spinoza is found in Leibniz's letter to Henry Justel, earlier in the same year (February 4/14, 1678 [PA., II, i, 393]): "The posthumous works of the late Mr. Spinoza have at last been published. The most important part is the Ethics, composed of five treatises: on God, on mind, on human servitude to affections or on the force of the affections, and on human freedom or the power of the understanding. I have found there a number of excellent thoughts which agree with my own, as some of my friends know who have also learned from Spinoza. But there are also paradoxes which I do not find true or even plausible. As, for example, that there is only one substance, namely, God; that creatures are modes or accidents of God; that our mind perceives nothing further after this life; that God himself does indeed think but neither understands nor wills; that all things happen by a kind of fatal necessity; that God does not act for the sake of ends but only from a certain necessity of nature. This is to retain in word but to deny in fact, providence and immortality.

"I consider this book dangerous for those who wish to take the pains to master it. For the rest will not make the effort to understand it."

No. 20. ON THE ETHICS OF BENEDICT DE SPINOZA

182. An important distinction for Leibniz, as the following comments show, for the individual monad is in itself but cannot be conceived adequately except in terms of its relations to God and to other monads. This criticism of Spinoza may be regarded as clearing the way for his own solution of the problem of the one and the many and therefore for his theory of representation.

183. For Leibniz's conception of attribution see No. 35, Sec. 8. A reciprocal predicate is one which mutually implies and is implied by the substance and is therefore complete enough to include the total meaning of the subject. An essential predicate may be any component of this, while a primary essential predicate is one not further reducible, or one of the "simple" concepts out of which the law of the individual nature is compounded.

184. The principle of equipollence is a methodological application of the

law of identity to particular fields of knowledge, in the realms of both the possible and the existent. In general, it is defined in terms of successful substitution; for example, in mathematics, a function for its dependent variable; in logic, a definition for its definitum; in geometry, congruent or (in less complete concepts) similar relations; in dynamics, the quantitative relations among effects for those among causes, or work done for energy expended, and the converse.

185. This is reminiscent of No. 14, I, and the discussion with Spinoza which it involved. In this discussion it should be remembered that Leibniz frequently shows that neither extension nor thought is a simple concept. But Leibniz's difficulty here is with the issue whether substance is simple or not, as his comments on Propositions [illegible] and 10, below, show. Leibniz dislikes the term "attribute" and is not sure whether to equate it with a primary essence or with a total or complete essence.

186. And are therefore not attributes as simple primary concepts (see No. 25 and n. 148). Ultimately every substance has only one essence, though this is complex and complete, taking the form of the individual notion or law. The use of the term "express" is not yet Leibniz's but suggests a duality of essence and attribute (see n. 187).

187. Leibniz was thus one of the first to note that Spinoza's attributes may be taken in a subjective sense.

188. Note that Leibniz here sharply differentiates logical possibility and necessity from existence and thus rejects the general ontological principle that essences exist, though they *demand* or *strive for* existence. Instead he here appeals to experience to establish existence. Though he has not yet rejected the ontological argument for God, therefore, he here admits that it does not establish the existence of primary concepts in the commonly accepted sense of existence. See n. 194, below.

189. See Spinoza's *R. Descartes Principia philosophiae more geometrico demonstrata, Book I, Proposition 19, together with [illegible] and 6. The proof referred to* is the ontological argument.

190. Marginal note: "It follows from this proposition, contrary to Spinoza himself, that not all things are necessary. For if the essence of a thing does not involve its existence, it is not necessary."

191. The pivotal term here is "express," which Leibniz is already interpreting to involve an epistemology of symbolic representation, a view which supports his pluralism and phenomenalism (see Proposition 30, below).

192. This general argument is refined in No. 51. Leibniz here reasons from his own pluralism, finding the basis for unity (i.e., harmony) in the conditions of our knowledge of things or, specifically, in the interrelations of representation by which each individual reflects the entire universe.

193. Leibniz miswrote: "nec posteriora priorum esse causam plenam," an obvious slip of the pen.

194. See Proposition 33, above. This is the point to which many of Leibniz's comments have been leading; not all possibilities exist, as Spinoza holds (see No. 31, I and II).

No. 21. WHAT IS AN IDEA?

195. The "near faculty" is defined in No. 11, II (comment on page 39 of Foucher's reply to Gabets). The "near" or immediate faculty of thinking seems to be that of the intuited pattern of thought itself, while the "remote" ability involves the reference of this given unity of symbol and objective structure to further objects not yet known. When these are known through rational deduction or inference, we have new ideas.

No. 22. Letters to Nicolas Malebranche

196. The work appeared anonymously. It contained an apology for Christianity in dialogue form, and from the Cartesian point of view. Leibniz made extensive notes on it (PA., II, i, 442-54).

197. Malebranche, however, supplied merely a confirmation of this Leibnizian opinion and was not its source, as some interpreters have held (see n. 126, above).

198. Jean Prestet (d. 1690) published his Eléméns des mathématiques in 1675. Wallis and others regarded Malebranche as the author of the anonymous work, to which Prestet, however, attached his name in the second edition, in 1689. Though he distinguished himself in theory of numbers, of combinations, and of equations, Malebranche reported in his next letter that Prestet had withdrawn from mathematical work and entered the Oratory but was preparing a revision of his Elements.

199. In his brief reply (G., I, 329), Malebranche ascribed the authorship of the Conversations chrétiennes to his pupil, the Abbé Catelan (who was later to take issue with Leibniz's criticism of the Cartesian principle of the conservation of quantity of motion). Malebranche defended Descartes but was not inclined to enter into an argument. That this did not deter Leibniz, the following letter shows. Meanwhile another anonymous work, which Leibniz assumed also to be Malebranche's, also reached Hanover.

200. In his brief reply of July 31, 1679, to this letter (G., I, 339-40), Malebranche wrote: "The author of the Meditations on Metaphysics is the Abbé de Lanion. Although he did not set his name to it, he is not concealing it; I know this because he has told me so, and many other people whom I know. So please do not ascribe this work to me."

The Meditations sur la métaphysique, according to Pierre Bayle, appeared with the author given as Guillaume Wander. It was purportedly printed in Cologne but apparently actually printed in Paris itself in 1678. Bayle's edition, in Recueil de quelques pièces curieuses concernant la philosophie de Monsieur Descartes (1684), is the best available, since the first edition was withdrawn, and copies were scarce even when Bayle prepared his edition. The influence of Malebranche is obvious.

201. Marginal note on Leibniz's copy: "However, I conceive the highest perfection absolutely; otherwise I could not apply it to a number, where it is applied unsuccessfully."

202. The warm friendship between Malebranche and Arnauld was to end in 1683 in the celebrated controversy over the nature of ideas (cf. No. 33 and n. 301).

No. 23. Two Dialogues on Religion

203. Nicolas Steno (1638-87) was a Danish anatomist and physician of distinction who had abandoned his science upon entering the church in 1667. Leibniz had more regard for his past science than for his present theology. On his biological achievements see E. Nordenskiold, The History of Biology (New York, 1928), pp. 155-58. His paleontological studies are reflected in Leibniz's own studies in the Harz Mountains, reported in the Protogaea.

204. This paragraph and what follows echo the well-known controversy which Richelieu's Catechism (1637) had aroused. Poliander proposes essentially the view there formulated, which was attacked by Seguenot and other early Jansenists.

205. On the spirit of the phrase "à la mode" see Hazard, op. cit., I, 81-82.

206. Leibniz had written "to judge" but struck it and substituted "to rule."

207. "They who lead many into righteousness shall shine forth as stars."

208. "Most blessed they who know their own good."

209. Baruzi comments on the evidences of religious exaltation in the last two speeches, reflected even in the handwriting of the manuscript itself, which overflows its margins. Of the last page he says: "The appearance of this page is admirable. Very few periods. The rhythm is visible even in the writing." The ease with which Leibniz slips into scriptural phrases should refute the opinion that he was unfamiliar with the Bible.

No. 24. On the General Characteristic

210. See Cout. L., pp. 134-40.

211. Neither Oldenburg nor Tschirnhaus fully grasped Leibniz's descriptions in his letters. Huygens failed to take seriously both his universal characteristic and his new geometry of situation. Not until the late nineteenth century was the significance of Leibniz's efforts understood.

212. See Cout. L., chap. iii. The allusion is probably to Dalgarno and John Wilkins, in whose proposals for a universal language Leibniz early became interested (cf. New Essays, III, ii, 1).

213. Note that Leibniz has here resolved the distinction between terms and propositions. Thus "man is a reasonable immortal animal," to use the example in No. 25, may be treated conceptually or as a structure of propositions inherent in the definition; in either case the expression is $x = abc$, which implies such propositions as all men are rational, immortal, animal, and also some animals are immortal, rational, men, etc.

214. See n. 99. Leibniz highly esteemed Jung's discovery and analysis of nonsyllogistic forms of inference (cf. New Essays, IV, xvii, 4).

215. One of the delusions under which Leibniz continued to labor much of his life was the simplicity of this project; this was the result of his conviction that the simple concepts are independent of each other and relatively few in number.

216. See Nos. 26 and 40 for examples of the logical calculus, which Leibniz thus considers as the formal development of his general characteristic and upon which he depends to prove his case. But compare the statement to Tschirnhaus (No. 19 and n. 178).

217. "Coccysm" was proverbial for wordiness or redundancy, from the reputation of John Cocceius, professor of theology at Leyden, and his followers.

218. In what follows Leibniz makes an early attempt to show that identity, contradiction, and sufficient reason, and the operations with them, apply to judgments of existence as well as to truths of reason. In general, his view is that these principles have particularized application to contingent truths, though the complete analysis lies beyond us. But he fails to show why the application of the subject-predicate proposition to created substances allows for freedom; the several parts of his explanation do not cohere, especially since the factor of incompleteness in contingent truths is placed in the predicting agent and his limitations rather than in the nature of the substance to be known.

219. For the reason that causes which we may discover for existing events are only partially determinant; complete causality would involve the infinite analysis of which we are incapable. Yet the individual substance seems to be itself completely determined.

220. All propositions are thus analytic, though all factual judgments whose subjects are not substances but mere partial concepts are only virtually so. See No. 26 for the sense in which Leibniz regards particular judgments as analytic.

221. The general principle of equipollence or equivalence (cf. n. 184) is thus derivable from the principle of sufficient reason.

No. 25. ON UNIVERSAL SYNTHESIS AND ANALYSIS, OR THE ART OF DISCOVERY AND JUDGMENT

222. Cout. L., p. 189, n. 1; p. 323 n. See also the introduction to No. 24, above.

223. See n. 213. This is in effect a criticism of Aristotle's theory of the definition and of the hierarchical implications of a subject-predicate viewpoint. If carried through, this change would have led to a purely relational logic. The unsolved problem in Leibniz's logic is thus the reduction of complex terms, or relational propositions, which apply to existence, to propositions whose predicates are all included in their substantial subjects.

224. Athanasius Kircher's *Ars magna sciendi sive combinatoria* appeared in Amsterdam in 1669, three years after Leibniz's *De arte combinatoria*.

225. Euclid's *Elements*, Book iii, Prop. 20.

226. Leibniz has in mind Anselm's *Liber apologeticus adversus respondentem pro insipiente*, a reply to Gaunilo's attack on the argument in the *Proslogium* in the *Liber pro insipiente adversus Anselmi in proslogio ratiocinationem*.

227. See n. 166, above.

228. Cf. New Essays, IV, ii, 1: "In this way all adequate definitions contain primitive truths of reason and consequently intuitive knowledge. It can be said in general that all primitive truths of reason are immediate with respect to an immediateness of ideas." In No. 33, where the kinds of knowledge and definition here described are discussed in more detail, Leibniz suggests that, though we cannot give good examples of adequate intuitive knowledge on the part of man, there is a kind of adequate knowledge in which we use symbols to retain the primitive elements which we cannot retain in an intuited whole.

229. For a further development of this criterion of the truth of contingent propositions see No. 39.

230. De utilitate credendi ad Honoratum. Like Hume, Leibniz recognizes psychological grounds for empirical judgments. But, unlike him, he holds that logical analysis and synthesis, aided by real definitions, reveal an inhering but abstractly necessary order within these judgments, so that scientific analysis proceeds from observations to causal judgments and functional laws.

231. Thus both analysis and synthesis rest upon a demonstrative structure of truth and upon an analytic theory of meaning; the direction is determined by whether the unknown is the relatively simple or the relatively complex. It is noteworthy that Leibniz subordinates both perceptual data and hypotheses to his analytic conception of truth. Synthesis proceeds from the simple, whether abstract or concrete, to the more complete, from a plurality of predicates to the determined subject which is equivalent to them; analysis in the opposite direction. Leibniz would recognize no induction by simple enumeration but would insist that scientific generalization involves intensional meanings and that abstract analysis of observations must precede synthesis. Cf. Introduction, Sec. IV.

232. Cf. Cout. OF., p. 351: "Analysis is through a leap, when we begin to solve the problem itself, with no other assumptions; . . . analysis is by degrees when we reduce the proposed problem to an easier one, and this to an easier still, etc., until we arrive at one which is within our power." See also ibid., p. 558, where the latter method is called "anagogic analysis." Leibniz's own examples include the reduction of quartics to quadratics and the analysis of higher curves by decomposition into simpler ones.

233. Descartes, Responsio ad secundas objectiones (Adam and Tannery, VII, 155-56).

234. See No. 27.

No. 26. Two Studies in the Logical Calculus

235. Discussions of these papers may be found in Cout. L., chap. viii, and in the works by Durr and Matzat given in the Bibliography.

236. That is, the syncategorematic sign, including that of quantity: all or some. Note that Leibniz neglects negative propositions, which he rules out below in Section 8.

237. The distinction between "direct" and "oblique" relations originates

in Aristotle's *Prior Analytics* i. 36. Terms are directly related when they can be combined by multiplication (or addition) alone. Terms enter a proposition obliquely when they involve a relation other than combination. Leibniz's best definition of these relations is in the letter to Gabriel Wagner (No. 48). Though he often touches upon oblique relations, he never deals systematically with them, because his logical calculus does not advance beyond the multiplication (or addition) and resolution of terms and categorical propositions. His recognition of oblique relations reflects the inadequacy of his theory of propositional inclusion to cover the existence of a plurality of substances and their interrelations.

238. To simplify the exposition, we omit Leibniz's second example (gold is the heaviest metal), which adds nothing to his analysis.

239. *Elements*, Book I, Definition 4: "A straight line is that which rests evenly between its extreme points.

240. Couturat notes: "All of these considerations are relative to the point of view from which they are understood." Thus from the finite and incompletely analyzed level of knowledge, the predicate of a particular proposition may contain the subject, and propositions may be synthetic as well as analytic.

241. Leibniz, it must be remembered, is here and throughout this study (with the exception in Sec. 12, below) discussing intensional meanings, not classes.

242. Leibniz's reduction of negative logical relations between affirmative terms to the denial of an affirmative proposition supports his conception of the ontological significance of logic. It also saves him from an analogy between logical negation and physical resistance and opposition.

243. Leibniz therefore explicitly recognizes the possibility of an extensional logic of inclusion, with laws inverting his own intensional ones. His reason for clinging to the intensional position must be sought in his conviction that truths of reason are prior to truths of fact.

244. Leibniz seems to have found himself betrayed by too close adherence to a logic of genera and species and now seeks a more general treatment of particular propositions. In the papers which continue this study (not here translated) he analyzes the particular proposition mathematically as one whose terms have a common factor (Cout. OF., pp. 64-65).

245. The Latin is translated literally to avoid implying an extensional interpretation such as "all men are animals" suggests.

246. Leibniz is thus interpreting the combination of terms as addition rather than multiplication, as he continues to do in the studies of the 1690's (No. 41).

247. What follows is a marginal summary and systematization.

248. Marginal note: "These definitions are adapted to the Scholastic usage, but the difference between substantive and adjective need not appear in characters, and it serves no purpose."

No. 27. *Studies in a Geometry of Situation, with a Letter to Christian Huygens*

249. The essay (II) sent to Huygens is part of a more extensive study in geometry dated August 10, 1679, and published in GM., V, 141-71.

250. Cf. Cout. OF., p. 152, from 1680: "We will reduce equality to congruence, and ratio to similarity. Two things are equal if one can be transformed into the other." There can be little doubt that Leibniz was first influenced to undertake the reform of geometry through his reading of Hobbes, though he recognized the latter's mathematical inadequacies (GM., VI, 71-72). But to Hobbes's effort to restore the Greek foundation to geometry, as against Cartesian analysis, he added something entirely new and fruiful, the logical analysis of the conditions of congruence and similarity and a rigorous synthesis of geometric truth from these determining conditions. See n. 103.

251. Huygens' *Traité de la lumière* appeared in 1690. For Leibniz's analysis of refraction see No. 50.

252. The omitted paragraphs dealt with such mathematical problems as the solution of algebraic equations with the aid of tables, exponential equations, and the inverse tangent problem.

253. John Joachim Becher (1635-82) was an alchemistic adventurer and a founder of the phlogiston theory. Leibniz aroused his enmity by exposing his alchemical claims at Hanover.

254. For example, analytic geometry assumes the Pythagorean theorem in deriving the fundamental formula for the distance between two points and for the properties of straight lines based upon this.

255. $(\underline{Y})$ is equivalent to $\underline{Y}_1$, $\underline{Y}_2$, $\underline{Y}_3$, etc.

256. Leibniz's parentheses indicate that the sentence contains an interpretation which is not a part of the demonstration, since it assumes a straight line, which is still to be defined. See n. 258.

257. That is, to determine any specific member of the family of circles of whose centers the straight line *AB* is the locus.

258. That is, *AY* ♉ *BY*. Leibniz thus defines the straight line as the locus of all points $(\underline{Y})$ whose relations to three fixed points (in space) are congruent.

259. At this point the text in GM. becomes inaccurate and incomplete, and we follow the German translation (BC., I, 83) in using the accurate text in Uylenbroeck's edition of Huygens' correspondence.

     The operational principles involved in determining the intersections which follow are (i) that corresponding parts of congruent figures are congruent; (ii) that any point can be substituted for another whose relations are congruent to its own; and (iii) that things congruent to the same thing are congruent to each other.

260. This essay is undated but belongs to the geometric studies of this period. Cf. Cout. L., pp. 396-97.

261. Euclid's δεδομένα or *Data*, which was edited by Marinus of Neapolis, a pupil of Proclus, is discussed in Cantor, *Vorlesungen über Geschichte*

der Mathematik (4th ed.), I, 282-83.

262. Note that Leibniz's definition of similarity can thus be derived from the principle of the identity of indiscernibles, applied abstractly to those related qualities which are not observed simultaneously or through a middle term, as his postulate requires.

263. This axiom relates Leibniz's analysis of similars in geometry with his more general theory of definition and of analysis and synthesis explained in No. 25. Determinants are the components of a concept adequate for its real definition. Note that the principle of equipollence (n. 184) is here applied to equate the relations in known determinants to the relations sought—an anticipation of its later application in the definition of continuity.

No. 28. Letter to John Frederick, Duke of Brunswick-Hanover

264. "As far as the altars."

265. This outline of the Catholic Demonstrations differs in no essentials from that of the Mainz period given in PA., VI, i, 494-500 (cf. No. 5), except that Parts I and II of the earlier plan have been combined into a demonstration of natural religion.

266. It may be significant to note that Richard Simon's Histoire critique du Vieux Testament had appeared in 1678, one of the important beginnings of modern biblical criticism.

267. Innocent XI, pope from 1676 to 1689, opponent of the Jesuits and zealous worker for moral reform and the reconversion of Protestants.

268. Whatever this proposal may have been, it may never have been made, for John Frederick died on December 18 of the same year, on his way to the carnival at Venice.

No. 29. ON FREEDOM

269. See the distinction between possibility and compossibility made against Spinoza in No. 14, II, and in No. 20. Cf. nn. 188 and 190.

270. This point is discussed in somewhat more detail in the letters to Philipp late in 1679 and early in 1680 (No. 31), where the same passage is cited.

271. On the source and meaning of Leibniz's figure of the labyrinth see the Introduction, Sec. V and n. 22.

272. Reading seu for sen.

273. Reading sed for sic; in the errata F. de C. gives seu.

274. Reading proportione for propositione. Leibniz's mathematical analogy will be simplified if the reader thinks of a ratio rather than a proportion (see n. 275).

275. Basically, Leibniz here considers truths as analogous to the relations between numbers in the real number system, necessary truths corresponding to rational ratios between real numbers, and contingent truths

to ratios involving irrationals which can be resolved only serially. Thus 6/5 is perfectly analyzable by division, but $\sqrt{2}$ or π involves an infinite series.

276. On the middle science see the Introduction, Sec. V and n. 35.

No. 30. "First Truths"

277. "Sur la métaphysique de Leibniz (avec un opuscule inédit)," Revue de métaphysique et de morale, X (1902), 1-25.

278. Limiting itself to the a priori derivation of metaphysical principles, this paper illustrates Leibniz's inclination to view the universe from God's viewpoint rather than man's. Thus his failure to point out the empirical element which actually enters into his definitions and the assumptions implicit in them.

279. On the Aristotelian source of this principle, and Leibniz's interpretation of it, see n. 25 to the Introduction.

280. See Introduction, Sec. V, and the correspondence with De Volder (No. 54). There has been a tendency to interpret Leibniz's doctrine that there are no purely extrinsic denominations, expressed later in this paper, as an assertion of the internality of all relations, though it is sometimes accompanied with a distinction rather like G. E. Moore's between external relations and relational properties. Leibniz often says, it is true, that the relations between substances are added by the perceiving mind, as the term "denomination" suggests. But, in general, there are real relations between monads—those of representation—but every representative act involves an internal or intrinsic quality in the perceiving monad. The issue involves the nature of oblique relations discussed in n. 237.

281. That all truth is resolvable to identities is the assumption which Leibniz does not prove. That there are identities involved in all truth is one thing; that truth reduces to them, another, which presupposes the existence of perfect essence.

282. Cf. n. 263. The axiom in No. 27, III, and this are the first explicit statements, in these selections, of the principle of functional dependence, which becomes so important in Leibniz's conception of scientific method. Most compactly stated, the law is datis ordinatis, etiam quaesita sunt ordinata ("As the data are ordered, so the unknowns [or sought] are also ordered") (No. 37), and the law of continuity is usually interpreted by Leibniz in this functional sense.

283. Summa theol., i, quest. 50, ad 4. Cf. Discourse, Sec. 9 (No. 35).

284. After 1683 Antoine Arnauld was asserting, in controversy with Malebranche, that perceptions are essential modifications of the soul but that the soul can perceive external and even eternal objects. Leibniz himself anticipated this view with his own to the effect that external relations depend upon internal qualities or modes.

285. The distinction between physical action and metaphysical action is striking here; the theory of physical action between substances cannot be sustained after the nature of the monad is restricted to appetite and perception and after the physical studies of the 1690's. For the functional definition of external causality between substances see the Discourse, Sec. 15.

286. Forms are active principles. In an essay from the same period, called by Erdmann "On the True Method of Dealing with Philosophy and Theology," Leibniz wrote, after criticizing Descartes's theory of matter: "What then shall we add to extension to complete the concept of body? Certainly nothing which sense does not verify. Sense, namely, establishes three things at once: that we sense; that bodies are sensed; and that what is sensed is varied and composite, or extended. To the concept of extension or variety, therefore, is to be added that of action. A body is therefore an extended agent. It can be said that it is an extended substance, only if it be held that all substance acts, and all agents are substances. It can be shown adequately from the essential principles of metaphysics that what does not act does not exist, for there is no power of acting without a beginning of action. You say there is no little power in a bent bow, yet it does not act. But I say, on the contrary, that it does act; even before it is suddenly released, it strives. But all striving [conatus] is action. For the rest, much that is excellent and certain can be said about the nature of conatus and the principles of action, or as the Scholastics called it, of substantial forms" (G., VII, 326-27).

287. Existence could therefore be derived analytically only through an infinite analysis. Insofar as they conform to logical laws, our scientific formulas apply exactly only to incomplete or abstract concepts, but they are incomplete simplifications of existence and therefore do not determine it completely.

288. Gérauld de Cordemoi, Le Discernement de l'âme et du corps (1666).

No. 31. Selections from Leibniz's Correspondence

289. Philipp was the agent of the elector of Saxony in Hamburg and became librarian in Dresden in 1682. His interest in Descartes evoked Leibniz's criticism.

290. For the specific references in Descartes's Principles see the following letter.

291. Leibniz had written a paraphrase of the Phaedo in Paris and frequently cited and quoted this particular passage (Phaedo, 97-99) afterward. Cf. Discourse, Sec. 20, etc. (No. 35).

292. On Jung see nn. 99 and 214.

293. A criticism of Descartes's voluntarism follows. The whole letter is translated in The Philosophical Works of Leibniz, trans. G. M. Duncan (New Haven, 1908).

294. La Chaise, the probable addressee of this letter, was the Jesuit father-confessor of Louis XIV. Leibniz was neglecting no approach to princes or pope for the theological approval he sought. His diplomatic flattery of Jesuit theology at the very time he was seeking Arnauld's support reveals the courtier at his most expedient.

295. The context indicates that this is not the new geometry of location (No. 27) but the algebraic analysis of transcendental functions after the pattern of Descartes's geometry. In spite of his recent emphasis on force (cf. n. 286), Leibniz here seems to be thinking of the analysis of motion only.

296. The test of Descartes's theory and laws of motion is developed in Nos. 34, 42, and 46.

297. "A body is not necessarily of determinate extension but is inclined toward having one unless a stronger force impedes it." See the concluding paragraphs of No. 30.

298. Privy counselor of Brandenburg and chancellor of the university at Halle; a distinguished scholar and statesman.

299. Together with Bossuet, Peter Daniel Huet was responsible for the education of the Dauphin and edited the celebrated classics *In usum Delphini*, for which Leibniz had worked on an edition of *Martianus Capella* while in Paris. The work here referred to is Huet's *Demonstratio evangelica ad serenissimum Delphinum* (Paris, 1679). He was made bishop of Avranches after 1692. He had mediated the correspondence between Leibniz and Bossuet when it began in 1679.

300. Pascal died in 1662. The sister referred to was Gilberte, Mme Périer, who had cared for him until his death.

301. This controversy had begun with Arnauld's *Des vraies et des fausses idées* (1683); by the time of this letter Malebranche had published a *Réponse* (1684) and Arnauld a *Defense* (1684). Leibniz's notes on the controversy may be found in the *Journal of the History of Ideas*, VIII (1947), 449-66.

No. 32. ON THE ELEMENTS OF NATURAL SCIENCE

302. *Elementa physicae*. The connotation of the term "physics" is much broader than at present and is often as inclusive as "nature."

303. Bod. LH., XXVII, iv, 1-10. The *Elementa physicae* and the *Elementa de mente* had been companion projects of Leibniz since his pre-Paris years and were intended both for the Introduction to the *Catholic Demonstrations* (PA., IV, i, 494; see also No. 28) and for the *universal encyclopedia* (G., VII, 60, 65).

304. For an earlier account of phosphorus see Leibniz's instructions to Huygens in No. 27. Robert Boyle, inspired by hints about Brand's method, published accounts of his own experiments with the new chemical in 1680 and 1682, using the designations *The Aerial Noctiluca* and *The Icy Noctiluca*.

305. *Historia*. See No. 2, Sec. 32. In the definitions which summarize the present paper (sheets 7 and 8), Leibniz defines *historiae* as "singular truths of sense, like an account of a certain lunar eclipse."

306. Leibniz uses quality to include both sensory and nonsensory properties of bodies, as Boyle had done in *The Origin of Forms and Qualities* (cf. Nos. 1 and 70). Note that, in Sec. II of the present paper, "attribute" is used as an equivalent term.

307. Motion, size, and figure are the categories of explanation in Boyle's corpuscular philosophy. For their place in the geometry of situation see No. 27.

308. More details concerning this method of geometric definition through the intersection of loci are contained in No. 27, II, and No. 70.

309. For the tornatorial science see Cout. OF., pp. 525-26, where it is included in phoronomy or the science of motion.

310. Reading with the manuscript vasis for palis (Ger.).

311. Cf. No. 34, below, where Leibniz rejects the Cartesian principle of the conservation of quantity of motion, or momentum, about which he here expresses doubt and No. 46, II, where the conservation of total quantity of motion in a system is reaffirmed, on condition that directions of motion are treated algebraically.

312. See the Tentamen anagogicum, No. 50.

313. This is the end of Leibniz's plan. What follows on the same page differs in ink and script and was clearly added later. It is obviously the first draft of the opening sections in the Introduction which follows.

314. The figure treating science as a hymn of praise Leibniz probably owed to Boyle (cf. The Usefulness of Natural Philosophy [Birch, II, 52]). Cf. "the hymn of Galen" (G., VII, 71, 273).

315. Cf. Cout. OF., p. 224, in the list of contents of a universal atlas.

316. In his first draft Leibniz had named as examples of the probity required of the scientist also Gassendi and Joachim Jung of Hamburg. His demand is all the more remarkable at a time when scientific jealousies were bitter and persistent.

317. Leibniz's nearest approach to the fulfilment of this remarkable prophesy is the principle of the conservation of total force and total direction of motion in a system of bodies (No. 46).

318. By 1686 Leibniz had concluded that an infinity of steps is involved in the a priori derivation of truths of fact and that this is therefore impossible for man. See also No. 29, above.

319. This is the method of establishing universal causal laws. Note that Leibniz distinguishes uncertainty in scientific conclusions which arises from the inadequacy of method (hypothesis and analogy) from uncertainty resulting from the impossibility of enumerating all the causal factors involved in a problem. Hence his frequent emphasis upon exhaustiveness in the enumeration of qualities. The experimental potency of the method of difference is here not yet apparent.

320. Leibniz here uses the term similaria, which is translated by his more general term homogeneous, basic for his mathematical and metaphysical analyses. The relation between similarity and homogeneity is alluded to in Part I of the present essay and treated more clearly in No. 70.

321. This frequently repeated attempt at the philosophical synthesis of mechanical and final causality (cf. No. 35, Secs. 19-23, No. 50, etc.) follows the argument of Boyle in The Origin of Forms and Qualities and elsewhere, save that Leibniz substitutes mechanical philosophy for corpuscular philosophy, Boyle's term for his own position.

No. 33. MEDITATIONS ON KNOWLEDGE, TRUTH, AND IDEAS

322. See n. 301.

323. In the *New Essays*, II, 5 (G., V, 116), Leibniz assigns these concepts (called by Locke simple ideas which come from several senses) to the common sense (Aristotle *De anima* ii. 6) but identifies the common sense with "the mind itself, for they are ideas of the pure understanding, which relate to the external world and which we perceive through the senses."

324. See n. 166.

325. On Leibniz's identification of simple concepts with the perfections of God see the Introduction, Sec. V; see also Nos. 14 and 16 and n. 148.

326. On this effort to reduce Euclid to syllogistic form see Cantor, *op. cit.*, II, 553.

327. *Art de penser*, Part IV, chaps. ix and x. Leibniz had read Pascal's *De l'esprit géométrique* in Paris (Cout. OF., p. 181).

328. This is another allusion to the Arnauld-Malebranche controversy. Arnauld had attacked Malebranche's view that we see objects by means of ideas in God's mind and had asserted that perception is esentially a modification of our own soul. See also n. 284.

329. This comment refers to Malebranche's theory of an intelligible extension in God, to which Leibniz here gives qualified approval, though he insists that this does not absolve God from particular knowledge, as Malebranche had held. Cf. Leibniz's theory of the *immensum* during the Paris period (No. 12).

No. 34. A BRIEF DEMONSTRATION OF A NOTABLE ERROR OF DESCARTES AND OTHERS CONCERNING A NATURAL LAW

330. *Principia philosophiae*, Part II, Secs. 48 ff. See also Leibniz's critical analyses in the corresponding sections of No. 42.

331. Leibniz's conclusion may be summarized as follows. According to the law of falling bodies, $d = \frac{1}{2}gt^2$. But $v = gt$; hence $v^2 = 2gd$, or distances vary as the squares of velocities. More generally, then, Leibniz holds that work accomplished, measured by the motion of a body through a horizontal distance, is proportional to a quantity of force accumulating through time and is therefore an integral or summation of successive initial impulses themselves whose effects in velocity are conserved and accumulated. It is therefore proportional to v^2 rather than to v. Forces in equilibrium are special cases of the more general equation between force exerted and work done, when the force remains dead (or is restricted to momentary acceleration).

For the relation among force, energy, and work the student should consult such standard works in theoretical mechanics as that by Sir James Jeans. Kepler's, but particularly Galileo's, analysis of force (as inertia times acceleration, as opposed to velocity) is important in understanding the background of Leibniz's thought. But his conclusion itself is first found in Huygens' *De motu corporum ex percussione* (1668), where Proposition 9 affirms that in a case of colliding bodies the sums of the products of m and v^2 remain constant. For these historical relations see E. Hoppe, *Geschichte der Physik* (Brunswick, 1926), pp. 60 ff. On the issue at stake between Descartes and Leibniz see Mach, *The Science of Mechanics* (5th ed.), pp. 364 ff. See also nn. 95 and 97 in Vol. II of these selections.

332. In the case of static machines, equilibrium requires that the common center of gravity of the system not be effected by virtual displacements within the elements of the system. But these momentary impulsions to displacement or conatuses (ds/dt) are proportional to velocity ($v = ds/dt$), and Descartes's principle thus applies. In the case of living forces, or forces operative through time, on the other hand, the distance is an integral of the velocity and thus proportional to v^2.

333. Honoratius Fabri, *Physica, i.e., Scientia rerum corporearum in X tractatus distributa* (Leyden, 1669); Claude François Déschales, *Cursus seu mundus mathematicus* (Leyden, 1674); Giovanni Alfonso Borelli, *De motionibus naturalibus a gravitate pendentibus* (Leyden, 1686). Huygens' *Horologium oscillatorium* (1673) had, like his earlier work on impact (n. 331), involved the new measure of motive force and was therefore opposed by Cartesian physicists.

334. The definition of energy as capacity to do work is found in Kepler and Galileo (Hoppe, *op. cit.*, p. 63). Descartes discusses the relation with Mersennes, July 13 and September 12, 1638 (Adam and Tannery, *Correspondence*, II, 222, 352). Samuel Morland's *Hydrostatics* appeared in 1695. Thus this supplement reflects the physical work of the middle 1690's. On Pascal's hydrostatics see Mach, *op. cit.*, pp. 66, 116-17.

335. A French translation of the *Brief Demonstration* appeared in this *émigré* journal for September, 1686, along with a reply by the Abbé Catelan.

336. Since the distance is proportional to the square of the velocity (n. 331).

337. This methodological assumption originated in Galileo's use of the pendulum and inclined plane in deriving the law of falling bodies. But it received brilliant development in Huygens' analysis of the oscillation center of a compound pendulum into the problem of simple pendulums with varied weights and lengths, which could be combined mathematically into a rigid system or released from it (see BC., I, 253, n. 189).

338. For a detailed discussion of the laws of impact and a criticism of Descartes's laws by means of the principle of continuity see Vol. II, No. 42. Until the appearance of Newton's *Principia* in 1687, the discussion of laws of motion was dominated by the problem of the impact of two colliding bodies. In Leibniz's later studies, however (cf. No. 46), collision becomes a special case of dynamic systems in which absolute force, relative force, and progress of direction are conserved.

No. 35. "*Discourse on Metaphysics*"

339. Leibniz had been more specific in the original draft, writing "les Spinozistes." On Leibniz's grounds for connecting Descartes's voluntarism and mechanism with Spinoza see No. 31, I and II.

340. "As a lesser evil is relatively good, so a lesser good is relatively evil."

341. In the original draft, "of the new Scholastics."

342. In the illustration originally added here, Leibniz used a geometrical example of the principle of the best possible or of maximal determination: "For example, there is an infinity of regular figures, but only one is the most perfect, the circle. If a triangle is to be made without any specification of the kind, God would certainly make an equilateral triangle, because it is the most perfect, absolutely speaking."

343. "To will the same thing and to dislike the same thing is true friendship."

344. Quietism is that extreme mystical doctrine according to which the soul, in surrendering itself to God, is emptied of its own desires and purposes and achieves a state of passive contemplation. The seventeenth-century movement was stimulated by the *Guida spirituale* (1675) of Miguel de Molinos, who died in the prison of the Inquisition in 1696. Among the leaders were Mme Guyon and Fénelon, whose *Explication des maximes des saints sur la vie intérieure* was a classic of the movement and a center of controversy, notably his own controversy with Bossuet.

345. Originally "the greatest perfection"; since pleasure is the perception of harmony or perfection, the two terms are psychologically and metaphysically analogical to each other.

346. Thus the principle of parsimony is equivalent to the principle of the best possible or of maximal determination.

347. In his *Treatise on Nature and Grace* Malebranche had restricted God's role in nature to the willing of general principles but not of particulars. See n. 329.

348. Originally Leibniz had added: "as well as the actions and passions of these creatures themselves."

349. See Introduction, Sec. V, and n. 85 to the texts. Note that individual substance and logical subject are united by Leibniz in the concept of *suppositum*.

350. "That every individual is there an infima species" (see n. 283).

351. Reading *provenante*, in accordance with the first draft, rather than *prevenante*, as in G., IV, 434.

352. Paracelsus' doctrine of an *Archeus* was popularized by the elder Van Helmont (Jean Baptiste, 1577-1644), whom Leibniz seems to have associated with it (G., IV, 217). For Leibniz's earlier sources for similar doctrines see No. 3 and n. 63.

353. The phrase that followed in the first draft was: "that bodies are not substances in strict metaphysics (this was indeed the opinion of the Platonists), and. . . ."

354. For the arguments for the relativity of space and time see the letters to Clarke (No. 71). They are phenomenal but not subjective in the sense of Berkeley and Hume, for they rest upon the well-ordered relationship of representational systems within existence which derive from the harmonious laws of the individual monads.

355. Identity of past, present, and future is thus assured by the continuity involved in the individual concepts of the monads. Reality which transcends the moment must be analogous to mind.

356. The question arises of the relation of this contingency in man's choices to the subordinate regulations of nature discussed in Secs. 7 and 17. These regulations are abstractions from harmoniously serial laws possessing the same kind of contingency (or self-determination) as man's, though sometimes much simpler. The question may well be raised whether these subordinate regulations, therefore, have the ontological status which Leibniz has assigned to them or are not rather phenomenal.

357. How our judgments can be exempt from the determination of our acts by the law of our nature, Leibniz does not say.

358. Solipsism and even a pluralism of island minds with private experiences are thus avoided, since it is a universal and common realm of meaning which we represent when we think. This Leibniz has shown in his earlier refutations of the arbitrariness of definitions and propositions (No. 17, etc.). This passage also shows the difference between Leibniz's a priorism and Kant's. Both find a region of universality and necessity as the basis for phenomena, and both derive intellectual activity from it, but Leibniz's conception is metaphysical from the beginning, in contrast to Kant's transcendentalism; the realm of universal and necessary truths is an absolute which serves as regulative of our experience rather than constitutive of it.

359. On Leibniz's notion of mass see n. 51. His concept of mass is clearer than in his early writings, however, being a quantitative measure of passive derivative force or inertia.

360. Leibniz here left a space in the manuscript to insert his paraphrase. His version may be found in G., VII, 335, or, more briefly, in No. 37. See also n. 291.

361. The reference is to the Theory of Abstract Motion, Sec. 20 (No. 8, I).

362. See the Tentamen anagogicum (No. 49). The argument was first published in "Unicum opticae, catoptricae et dioptricae principium," Acta eruditorum (1682).

363. To the old argument between Aristotelians and the moderns as to the nature of life, the discoveries made possible by the microscope in the seventeenth century added new arguments for both sides. Descartes, influenced by Bacon and Harvey, was of course the chief philosophical authority for mechanism, which was confirmed by the analysis of various organic systems and their functions, such as the lymphatic and other glands, the lungs, and the pyramid cells in the brain. Leibniz's opinion mediates between this mechanism and the extreme vitalism of those like Cudworth and More, and later even Stahl, who introduced animistic principles (see E. Nordenskiold, The History of Biology [New York, 1929], chap. ii).

364. On the problem of the relation of Descartes's optics to Snell's, see Mach, The Principles of Physical Optics, trans. Anderson and Young (1925), pp. 32-33.

365. See Nos. 21 and 33 on the nature of ideas; also nn. 284, 328, and 329.

366. Deleted in the first draft: "When I know the possibility of a thing merely through experience, because everything that exists is possible, my knowledge is confused. It is thus that we know bodies and their qualities. But when I can prove the possibility a priori, this knowledge is distinct."

367. Originally "subsistent." The two theories conform to Arnauld's conception of idea as the internal meaning of a perception and Malebranche's conception of an eternal object of our intellect.

368. The Scholastic interpretation of impressed species as mediating between the object and the intellect had led to a material interpretation of them supported by Suárez (De anima, Book iii, chap. 1; Book iv, chap. 2) and others. The view had been criticized by Descartes and Hobbes and was discussed by Malebranche in the Recherche, III, Part II, chap. ii.

369. Meno 82c-f.

370. "The light which lightens every man that cometh into this world" (John 1:9).

371. "The active intellect of the rational soul."

372. Malebranche had restricted the activity of the soul to willing.

373. "Who, he foresaw, would give themselves in faith.

374. Cf. Rom. 8:28-30, 9:14-29, etc.

375. See n. 6.

376. Thus Leibniz does not regard the soul as the form or activating principle of the body but views their relation as external and determined by the universal harmony. This view is often confused, however, by statements that every composite body (sometimes every living body only) has a uniting and reifying soul.

377. Originally Sec. 34 opened as follows: "I do not yet undertake to determine whether bodies are substances, speaking with metaphysical rigor, or whether they are only true phenomena like the rainbow; nor, as a result, whether there are substances, souls, or substantial forms which are not intelligent."

378. Originally, "no character [personnage]."

379. Originally, "the highest of the subalternate laws of his conduct."

No. 36. Correspondence with Arnauld

380. On his draft of the letter Leibniz noted, "Was sent in this form, June 1686"; in the edition of Arnauld's works it is dated July 14.

381. Leibniz's marginal note: "A full concept includes all the predicates of the thing; for example, of heat. A complete concept includes all the predicates of a subject; for example, of this heat. In individual substances they coincide."

382. See Arnauld's letter of May 13, 1686 (G., II, 28).

383. Thus there is a pure possibility which involves no decisions of God's creative will and includes the eternal truths of logic and mathematics. But these possibilities do not involve complete concepts and are therefore not determinative of existence. The class of existing substances, regarded as possible existences, involves God's choice or determination by the principle of the best possible.

384. G., II, 32-33.

385. "Under the principle of generality or essence, or of a specific or incomplete concept"; that is, a partial, abstract, and therefore not entirely determined concept. A warning may be needed that, in the discussion which follows, "specific" means "referring to a species." Man's knowledge of himself is, like his knowledge of other existence, limited to this incomplete kind, though his experience of himself is immediate. Cf. nn. 386 and 388.

386. The real self is therefore more than the object of reflection or inner awareness; self-knowledge involves the construction, so far as this is possible, of the law of the individual.

387. To do this was the task which Leibniz undertook in his metaphysical logic. The Generales inquisitiones, the most extensive discussion (though far from complete) of his logical theory, was written in the same year as the Discourse and this letter, 1686. It undertakes the logical synthesis of his metaphysics (Cout. OF., pp. 356-99).

388. Personal identity is therefore not given in self-experience alone but only in the law of the individual nature. Moral responsibility, on the other hand, depends more directly on the memory and enduring purposes which the inner sense makes possible. See the Discourse, Sec. 12.

389. "The principle of generality adequate for an individual." This involves God's process of selecting a concrete concept according to the law of optimal or maximal determination.

390. See n. 283. The reference is to Thomas' doctrine that all pure intelligences are infimae species.

391. Leibniz seems to say that it is intrinsic only to the complete idea in God's willed thought. But this would entail that only God's idea of the entire creation is a complete concept and that the individual concept is a completely determined concept only as it is contained in this.

392. See nn. 280, 284, and 391.

393. This is the point which Arnauld selects for further discussion in the later correspondence. In moving from the problem of colliding bodies to that of the relation of the mind to its body, the paragraph leaves it unclear whether Leibniz is assigning a soul only to living bodies or to inorganic ones as well (cf. n. 376). This ambiguity appears in some of Leibniz's later work. Compare the various discussions with Des Bosses (No. 62) with that in the two metaphysical summaries of 1714 (Nos. 66 and 67).

394. The corpuscular philosophy (as Robert Boyle called his system) must, insofar as Leibniz approves it, be understood, not as atomism, which he rejects except as a fiction, but as any philosophy which explains physical events mechanistically or in terms of magnitude, figure, and motion.

395. This is again the date in Arnauld's works; Leibniz marked his copy September, 1687. This is the last letter in the controversy, since Arnauld did not answer it, and Leibniz left shortly afterward for his journey of historical research. From its limited beginning in Arnauld's attack on the thirteenth proposition of the Discourse, the content of the correspondence had widened and its analyses had deepened. This letter is concerned primarily with two problems: (i) the theory of concomitance, with its explanation in the theory of representation or expression, and (ii) the nature of corporeal substance. Biological interests are prominent, and there are clear statements on the nature of the affections and of substance in general.

396. G. has belle for telle.

397. "A knot worthy for God to intervene ex machina." Loosely quoted from Horace (see n. 78).

398. "The just order of the heavens, the trustworthy ways of things, and the laws of the gods"—all this together the old man of Syracuse represented by his art.

399. Reading present for precedent (G., II, 115).

400. In the original draft the following note was put in brackets, to be omitted in the copy sent to Arnauld: "Strictly speaking, bodies are not impelled by others when a collision takes place but by their own motion or by their elasticity, which is also a motion of their parts. Every corporeal mass, great or small, already has within it as much force as it is able to acquire, but the directed impact of other bodies merely gives it direction, or, better, this determination of direction occurs only at the time of impact."

401. John Bacon is Baconthorpe, a fourteenth-century Scholastic with Averroistic leanings. Jean Fernel was a French physician of the sixteenth century; Philoponus or Johannes Grammaticus a Christian Aristotelian of the sixth. Gabriel Biel was the German Occamist whose writings influenced Luther. Note that Leibniz has a different group of documentations for the theory of substantial forms than in his youth (Nos. 3, 7, etc.).

402. That is, the transmission of the soul from parents to offspring.

403. Correspondence (Adam and Tannery), V, 267 ff.

404. See n. 288.

405. Cf. the concluding sections of No. 30 and n. 281.

406. Bracketed by Leibniz for omission in the sent letter: "If we take as the matter of corporeal substance, not its mass without forms, but a secondary matter which is the multitude of substances whose mass is that of the whole body, it can be said that these substances are parts of this matter, as those which enter into our body are parts of it. For as our body is the matter and the soul is the form of our substance, it is the same in this respect with other corporeal substances. I do not find any more difficulty here than in the case of man, where everyone agrees with this whole point. The difficulties which arise in these matters come, among other things, from the fact that we do not commonly have a sufficiently distinct concept of the whole and the part. In the last analysis, the part is nothing but an immediate com-

ponent of the whole and is in some way homogeneous to it. Thus parts can constitute a whole, whether it has or has not a true unity. It is true that a whole which is a true unity can remain the same individual in a rigorous sense even when it loses or gains parts, as we experience in ourselves. Thus the parts are its immediate requisites only *pro tempore*. But, if by the term *matter* we understand something which is always essential to the same substance, one can mean by it, in the sense of certain Scholastics, the primitive passive power of a substance. Matter in this sense will not be extended or divisible, though it will be the principle of divisibility or that which corresponds to it in the substance. But I do not want to argue about the use of terms."

407. Arnauld's misunderstanding seems to have good grounds (see n. 393).

408. *Recherche de la vérité*, Part III, chap. vii.

409. Marcello Malpighi (1628-94) was, after Leeuwenhoek, the founder of microscopic anatomy, and his studies of respiration, cell development, and other functions did much to strengthen the conviction that all life contains common principles. Together with Jan Swammerdam (1637-80) he established the theory of preformation which confirmed Leibniz in his conviction that every individual develops out of the law of its own nature.

410. See Nos. 34 and 37 and n. 335.

No. 37. *Letter of Mr. Leibniz on a General Principle Useful in Explaining the Laws of Nature through a Consideration of the Divine Wisdom*

411. For Leibniz's criticism of Malebranche's laws see G., III, 46-49.

412. In brief, the law of continuity holds that if $y = f(x)$, and there are two values x_1 and x_2 such that $x_2 - x_1 < d$, where d is any assignable difference, however small, then the corresponding values $y_2 - y_1 <$ any assignable difference as well.

413. *Principia philosophiae*, Part II, Arts. 46-47. Leibniz's more detailed use of the principle in analyzing the errors in Descartes's laws is found in No. 42, II, on Arts. 45-53.

414. See n. 394, above.

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